IN THIS ISSUE: Tendencies of Technical Education in the West

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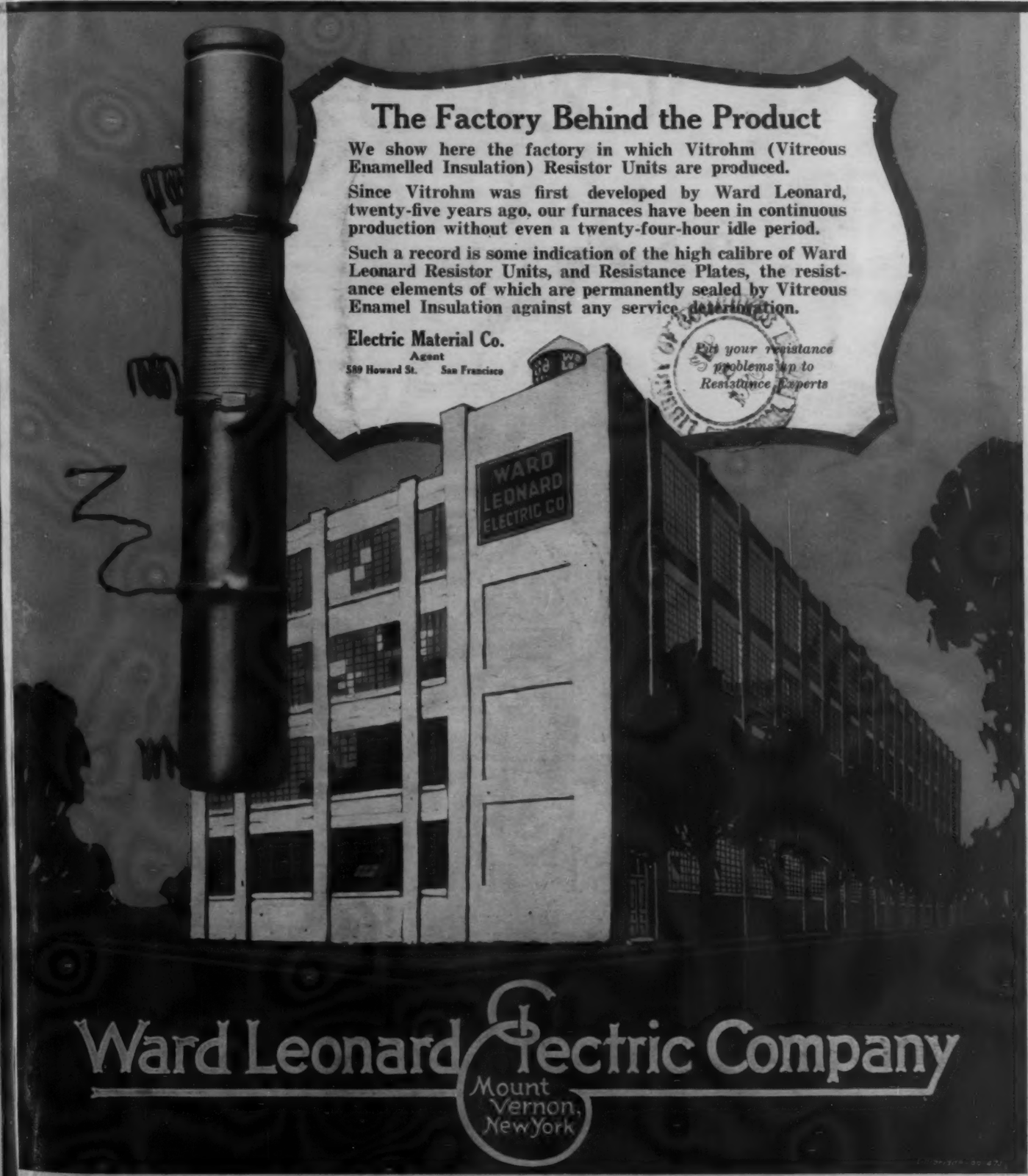
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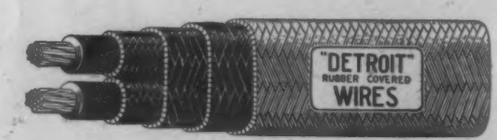

JOURNAL OF ELECTRICITY

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ROBERT SIBLEY, Editor H. W. L. GARDINER, Business Manager

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IN these great institutions of learning has been fostered the vision that has become the heritage of each of their graduates, leading them on to accomplish the seemingly impossible and to find the way out of the problems, technical and social, that have had to be solved by the men of the West. The spirit of the pioneers found expression in these universities and their belief in the possibilities of this vast empire, west of the Rockies, is the inspiration of those who follow in their footsteps.

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JOURNAL OF ELECTRICITY

DEVOTED TO THE UPBUILDING OF THE ELECTRICAL INDUSTRY IN THE WEST AND IN THE COUNTRIES BORDERING THE GREAT PACIFIC

Volume 45 SAN FRANCISCO, AUGUST 1, 1920 Number 3

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Publishers' Announcement

It is with great pleasure that the McGraw-Hill Company, Inc., hereby announces that the confidence it has always felt in the Pacific Coast, its resources, its past attainments and its vast possibilities for future development has during the past year been greatly strengthened due to the support and friendly good feeling that have been shown from all quarters of the West to the McGraw-Hill service on the Pacific Coast through the Journal of Electricity and the ten other engineering and technical magazines of our company. We have in view the enlarging of this service, the broadening of the activities of the Journal of Electricity to embrace to an even greater extent the industrial activities of the West and its possibilities for future growth and development.

To this end a reorganization of our Pacific Coast office has been found necessary. When the McGraw-Hill Company purchased the Journal of Electricity last year, plans were made to dissolve the Technical Publishing Company Jan. 1, 1920, but a delay was caused by the printers' strike in New York. Our plans now, however, are all perfected. After Aug. 31, 1920, the Journal of Electricity will be published direct by the McGraw-Hill Company, Inc., at its San Francisco office, Rialto Building, the Technical Publishing Company being dissolved. Under the new arrangement Mr. Robert Sibley, editor of the Journal of Electricity, becomes the executive head of the San Francisco office as chairman of the Pacific Coast Executive Committee, which committee consists of three other members of our Pacific Coast staff, H. W. L. Gardiner, who is to be the new business manager, N. A. Bowers and A. H. Halloran. The committee will not only direct the affairs of the Journal of Electricity, but also all of the Pacific Coast activities of the McGraw-Hill Company.

At the time of the purchase of the Journal of Electricity, Mr. W. M. Deming kindly consented to remain with the Technical Publishing Company as its president and general manager until the company was dissolved or other arrangements were made. As he is now leaving us I should like to take this opportunity to express my sincere appreciation of the work which he has done, and to extend to him the cordial good wishes of the many friends he has made in the McGraw-Hill Company.

JAMES H. McGRAW, President.

Demand for Better Technical Training

The Water Power Committee Report presented to the National Electric Light Association Convention at Pasadena during recent weeks has created a profound impression. That the vast sum of over $700,000,000.00 must be expended in hydroelectric development in the West during the next nine-year period not only awakens an interest in the possible purchasing power of the West throughout the manufacturing centers, but it also has a vital message here at home. To furnish the proper man power for undertakings which involve such vast financial investment, and which are of such prime importance to industry and agriculture in the West, a new and emphatic duty falls upon our universities.

To such institutions as the California Institute of Technology at Pasadena, the University of Southern California in Los Angeles, Leland Standard Jr. University at Palo Alto, the University of California at Berkeley, the University of Washington at Seattle, and Washington State College at Pullman, all of which are designed to train men to handle technical duties of the commonwealth they serve, this subject is of profound importance.

President Barrows, of the University of California, in an address before the San Francisco Electrical Development League recently, stated that the University of California was looking for every opportunity of increasing the service that institution could render to the people and industries of California and the whole West. It appears, without question, to the electrical industry that the following logic is unassailable: The future development of the industrial and agricultural resources of the West is inseparably bound up with the development of the potential water powers and fuels of this region. These will produce electrical energy to do the work of the West which cannot otherwise be accomplished successfully.

Abundant evidence is at hand which proves that in this district progress has followed, and will continue to follow the development of these natural

resources; and without such development progress will languish. In one comparatively small community alone it has been found that the shortage of sufficient electrical energy to supply all applicants, due to post-war financial conditions and the drought, has postponed the cultivation of thousands of acres of rich farm land and because of this fact the immediate construction of city homes representing an investment of ten million dollars was stopped.

The second premise is that the vast water powers of the West cannot be developed without the application of trained workers. The trained workers must be reared and educated where they may be imbued with the daring spirit and vision of the West. Thus alone can they carry out the magnificent program already visualized, which is indeed unique to this section of the world. An approximate census of the great power companies in the commonwealth of California alone shows that at this time there are over two thousand employes holding positions which call for the equivalent of a college education. Experience tells that the number of such employes will increase in almost direct proportion to the increase in the power capacity of the systems. Thus, in this decade, there will be required five thousand, or more, additional trained employes of college grade in this branch of the electrical industry alone.

The inevitable conclusion is that the University of California is not now doing its share in this vital problem. It should not leave the education of these important members of the industry to others, but should assume first place among engineering colleges. The present staff in the Electrical Engineering Department at this university consists of one professor, two assistant professors and one special instructor, although the department ranks fourth among the colleges of this institution. There is one assistant professor on leave. The total enrollment in the College of Mechanics is 615 students, most of whom take electrical subjects.

Before the beginning of another academic year the conditions must be improved and the alumni, and all others interested in the welfare of California's University, are watching the entire situation with the keenest anxiety and expectation.

Research and Industry

In summarizing before the A. I. E. E. convention the progress of electrical history during the early part of the 19th century, Professor Magnusson pointed out conclusively that of the six eminent physicists and philosophers who discovered the fundamental laws of electricity and magnetism and their inter-relations five were university professors, and the sixth an independent investigator. Today a survey of the field wherein research studies are made and new applications developed, shows that only a very small per cent of the investigators are within the walls of universities. All the others are connected with the research departments of manufacturering concerns. Great sums are spent for theoretical investigations, which may or may not lead to the development of apparatus for practical application at the time. Although it is regrettable that the universities have not their former comparative status, yet it is not illogical that those directly profiting from the studies should be the first ones to carry the burden of the expense.

The relation of this problem to the Pacific Coast is quite direct. On the Pacific Coast there are few industrial activities comparable in size with those in Eastern states, and as a result there is not as much research done here as in the East. Professor Magnusson gave as a corollary to this, that greater industrial progress would not be made without the foundation of industrial research. It of course follows that as the industries are not here to foster the research and as the industry will not obtain without research, the alternative is that the universities of the West regain the place once held by universities in research work. If the universities are suitably equipped and have proficient faculties, students who are capable of undertaking research work will be influenced to do this in the universities here, rather than enter the research departments of the Eastern manufacturers.

A Step in the Right Direction

The determination of the Northwest to reap the benefits of cooperation is seen in the significant fact that an executive committee has been formed in the state of Washington to carry on a cooperative campaign similar to that which has been conducted with such great success in California. Cooperation has been preached for so long that the electrical industry has come to the point where no banquet or convention is complete without at least part of the program being devoted to that subject. Everyone agrees that it is a wonderful thing to have a cooperative movement. Generally that is as far as it gets. Now that the Northwest has taken this vital step forward it is to be hoped that all the Western states will form cooperative campaigns that may eventually be welded into one big cooperative movement that will hold the entire West together so that this region as a whole may gather the benefits that are bound to come from such a movement.

Cooperation in Education

One of the impressive responses to the demands of the war period was the cooperative research work carried on by scientists from all the laboratories of the country. Each man carried on his own work but each had at his command the resources of the entire group. Scientists from one company worked in the laboratory of another, more fitted to the particular experiment they were carrying out, and universities pooled their resources in faculty and equipment in the interests of the important work in hand.

The experience is one of many aspects, but among the lessons which it taught was the value of exchanging laboratory facilities. The time may come when this is done between commercial companies, although for the present such interchange is only a matter of personal courtesy in special instances;

but there seems to be no reason why it should not be put into more general application by neighboring universities. Laboratory equipment for elementary courses is of course necessary in each institution for the great number of students who take such work, but specially outfitted laboratories for advanced study often mean a tremendous outlay, so that a college cannot afford to specialize along many lines. The European system of universities presupposes that the student will go from center to center to get the work which he wants, but our American system has developed along other lines. Why should not neighboring universities, of which there are a great number in the East and numerous instances on the Western coast, extend the courtesy of such specialized facilities to students of the other colleges and thus permit each institution to build up really complete equipment along its special line without having to scatter its resources?

Telegraph Service

The article on another page of this issue telling of the interesting apparatus used by the Western Union Telegraph Company carries with it another, and more important message. It is a message of service. Service that is not vital merely to the transmission of a message from one station to another, but essential for the successful continuation and growth of the business. Although a necessary adjunct to the financial and business life of the country, the use of the telegraphed message must be taught to the public. It has been found that the best way to do this is by the rendering of service in its broadest sense. This is natural as the telegraph company is a public utility and, in common with all such, rests upon the cornerstone of service. Without service it cannot succeed, and conversely, with more complete service, it will succeed the better.

Educating the Manufacturer

Those who attended the industrial lighting exhibit of the Pasadena convention were greatly impressed with the value of such a display as an object lesson for manufacturers and the thought occurred to many that such an exhibit should be a permanent installation in large cities, so that manufacturers could be taken to view the demonstration as part of the selling of adequate illumination. The California Electrical Cooperative Campaign has recently determined upon the opening of two such rooms, one in Los Angeles and one in San Francisco, the educational work in connection with which is to be carried on by the campaign's field representatives in these two cities. In keeping with its progressive work of the past, the California organization has seized upon an important new field of service. With its backing and support of the united electrical industry of its state, it is in a position to take the lead in such matters. Local organizations are following suit elsewhere and among the community needs of the electrical industry which these enlightened groups will meet, the opportunity to forward the cause of better lighting through the establishment of such illumination demonstration centers should not be overlooked.

Publicity for Engineers

The constitution for the new organization of the Federated American Engineering Societies as adopted by the organizing convention in Washington provides that "this organization stands for the principle of publicity."

The adoption of this principle as fundamental in so far as it signifies an utter abandonment of secrecy is in the spirit of science for which the engineer has always stood; in the sense that it involves an aggressive campaign of publicity, it means a new step for the engineer in the recognition of the ethical necessity of advertising. An amusing series of articles which appeared during the war attempted to prove that the way to win that conflict was to advertise the principles for which we fought to the opposing armies. In spite of the difficulties of reasoning with the contestants in a fist fight, it is nevertheless a fact that progress can only come through a clearer understanding of the issues involved in any question and that in a very real sense, the side which is best advertised, wins. In a democracy the whole fabric of conditions which surround living are determined by the enlightenment or ignorance of the public. The engineer has always stood in the forefront of progress and, in common with most of the elements which go to make up this vanguard, has made little or no effort to mold public opinion. His work is inconspicuous in nature—it is not, as a rule, until he has finished with it, that it comes to the attention of the public, and his opinion has had no such weight in forming public thought as that, for instance, of organized labor. And yet the hope of a republic is in the use which it makes of its experts. It is to the interest of the community as well as to the engineer that he make an active effort to advertise his standpoint—and the engineering societies have taken a step forward in thus taking up this responsibility.

Accounting Systems

Since every successful business has recognized the fact that an accounting system is a valuable asset, it is time for the contractor-dealer to hold a little business session with himself and find out if his present system of accounting is doing all that it should for him. The time has passed when a man who carries his office under his hat and banks in his hip pocket can secure the credit which is essential to modern business. The average contractor-dealer has graduated from the class of curbstoners and has established himself as a legitimate business man, and if he is to make a success as a contractor or as a merchant of electrical wares he must know exactly where he stands financially. To do this he must have more than simply a cash book and a ledger on his desk. He must establish or buy a system of classified accounts so that he may determine the exact cost of handling each kind of appliances, and so that he may know what lines he

should push to get the greatest profit out of his business. While any accounting system is better than no system at all, there is a standard accounting system that has been especially designed to meet the need of the electrical contractor-dealer and is put out by the national association. The contractor should keep exact costs on each type of construction work so that he can bid more intelligently and get away from guesswork which is injurious to him and to the industry.

A recent questionnaire sent out to get the data on the cost of handling motors divulged the fact that the majority of the dealers who handled this type of electrical goods did not know what it cost them to do business. Some of these same dealers complained that they were unable to secure credit at the banks. The answer to this is obvious. If those dealers had known exactly what it cost them to do business there is no doubt that their bank would have been willing to extend them a liberal credit.

A good accounting system is often the stepping-stone to better business and has many times turned a merchant from failure to success. It is the best little efficiency engineer that it is possible to have in a business for it shows up the leaks, the waste and the useless expenditures. It shows the profitable lines of business and those lines which are slow. It acts as a buying guide and will offer many suggestions for seasonal advertising. It is the one thing that can make the red ink on the ledger turn black.

Changing Values

The need of a different system of rate fixing is clearly shown by the recent increase in the price of fuel oil, following as it did the effective increase in rates allowed a large Western power company by just two days. On the basis of an increase in the price of fuel oil in the early part of this year most of the California power companies applied to the commission for an increase in rates. This increase was allowed by the commission to insure the power companies a reasonable surplus over increased operating expenses, and now that another unexpected increase in operating expenses has occurred the power companies are faced with the alternative of either losing the fair margin of profit which the commission has claimed they are entitled to, or going to the expense of making another application for a further increase. If they adopt the latter procedure there is no assurance that when it is granted there will not be a still greater increase in the cost of oil that will make another increase in rates necessary.

A flexible system that would permit a sliding rate scale that would at all times allow a fair margin of profit over operating expenses would be a great help to the power companies in these days of changing values. When the peak of high prices has been reached and the price of labor and commodities begins to reach a normal plane, such a system would protect the public from excess prices for power and light. Several schemes have been suggested for accomplishing this purpose and at this time it would be an excellent idea to investigate these more thoroughly with the idea of changing the present unsatisfactory system of rate fixing.

Economies in Joint Operation

A recent compilation of western data on electric generation was worked out upon information furnished by the respective power companies. Anticipated loads for the next decade and the construction which would be necessary to meet them were being determined and the figures near completion when it was discovered that two of the companies which had been reckoned in separately had within that period joined forces and that their peak loads and requirements must be figured on a joint basis. The figure of saving ran into the millions—this irrespective of the fact that the two companies had for some time been exchanging current to ease each other's peaks.

It is only when some such concrete instance brings figures to the attention, that one realizes the magnitude of possible savings involved. Commissioner E. O. Edgerton of the California Railroad Commission in one of his recent addresses suggested the eventual possibility of all companies within a state combining in the interest of economical service. At the present time, the subject is a purely academic one, but it is not foreign to the spirit of the West, which already is distinguished by the size of the companies which serve it and by the cooperation and interconnection of these several units for the public benefit. Undoubtedly such a single corporation would have drawbacks as well as advantages, but it is to the credit of the electrical industry that it is not afraid to discuss its possibility in the light, not of the officials who might lose positions, but of the consumer's welfare.

The Tired Business Man

appreciates almost as much as his wife does, the restfulness of a smoothly-working household, free from drudgery and from the eternal servant problem.

The August 15th issue of the Journal of Electricity will feature

The Electrical Home

and will show how adequate wiring, proper illumination, and electrical labor-saving devices are increasing beauty and leisure in the modern home.

Technical Training

(What emphasis do the universities lay upon their engineering departments? Have they enough teachers, adequate equipment, a satisfactory curriculum? Are more students demanding engineering training than formerly, and are they getting what they want? These and other questions are taken up in the following article, compiled from data received from various educational institutions throughout the country.—The Editor.)

In order to gather together information as to the present status of training being given to students in engineering courses in the universities of the nation, inquiry was made of a number of representative universities in the country concerning their enrollment of faculty and students in the various engineering colleges. As a correlated subject, an inquiry was made of a number of prominent engineers and executives in the West to determine their attitude toward the training usually received in university courses.

As the progress of the electrical industry demands the turning out of thousands of young men to fill the positions of engineers and executives in the manufacturing concerns and power development companies, it is fundamentally important that these men receive the best possible training for the courses they will pursue in after life. Some of them are receiving this at the present time, but others are not. In some cases the lack of proper training is due to a lack of proper foresight on the part of the student himself; in others the courses as laid out by the various colleges and universities are not best suited to his needs; while in yet others, while taking the proper course, he does not receive the fullest possible returns from the time invested, due to the lack of university facilities, either of faculty or equipment.

Specialized Technical Work

The indications are that the universities of the country generally are so arranging their engineering curricula as to give the student those studies which are now proving to be most desirable. In some cases colleges, particularly technological colleges, are confining themselves to the strictly technical subjects, and this is, of course, desirable as there is a necessity for a certain percentage of the graduate engineers to be highly versed in the more theoretical branches of their profession. This training will fit them to become research engineers or designing engineers.

The field of the research engineer is rapidly growing. Perhaps it is not untruthful to say that there would today be less foundation for the remark made fifty years ago by a certain official in the patent office, to the effect that he thought it necessary to resign from the patent office as he felt that there was nothing left to be invented. A most casual survey of the progress and development in electrical apparatus and applications during the past ten years will prove beyond doubt that the development of electrical apparatus is far from reaching the knee of the saturation curve. In all branches of the art, whether it be generation of power, its transmission, distribution or the transmission of speech or signals by wire or through the air, boundless possibilities are presented for the ingenious inventor and the thoughtful research man.

A peculiar type of mind is required to devote a life to research or development work. Great patience and the ability to concentrate for long periods of time on one subject are the fundamental requirements, and the training of men for such work is the duty of the technological college.

Lack of Funds in Universities

Students who are taking or preparing to take courses in colleges or universities not thoroughly equipped with the necessary laboratory and field apparatus, or having insufficient faculty to care for the students enrolled, are confronted with a matter of economics. The only apparent reason why a university or a college does not equip its laboratories with all the apparatus conceivable for the training of its students, or which does not employ enough or the proper kind of professors and instructors, is one of finance.

Privately supported institutions such as denominational colleges and those receiving their incomes from tuition fees are in a somewhat better position than state institutions in that they are not limited by law to a certain fixed income, and their finances may be augmented by further contributions from their supporters or through increases in the tuition fees. The latter course might result in a decrease in the number enrolled, which so far as that one institution was concerned would be beneficial in that it would reduce the enrollment to a point where the equipment on hand and the faculty in attendance would be sufficient to care properly for their needs.

State institutions depending upon their income from the state taxes are, during recent months, making progress in the matter of having their income increased. For example, the University of Oregon has just recently succeeded in obtaining the passage of state legislation which will increase the tax rate for raising money for its support. At the present time the Alumni Association of the University of California is very active in behalf of a measure which will increase the income of that university by some $2,000,000 per annum. With such increases in their income, proved to be so gravely needed, these state institutions will find themselves upon a firm foundation, and thereby be able to maintain their logical places among the educational institutions of the country.

Proportion of Faculty and Students

The tabulations given showing the number in the faculty and the number of students enrolled in fifteen universities is of very general interest.

An inspection of this table shows that Colorado Agricultural College and the University of Utah have respectively 2.7 and 4.7 students per faculty member, but as these figures refer only to Junior and Senior students as stated, they are slightly mislead-

UNIVERSITY	Electrical Engineering		Mechan. Engineering		Mining Engineering		Civil Engineering		Totals, Engineering Departments		Approx. No. Engineering Students per Teacher
	Faculty	Students	Faculty	Students	Faculty	Students	Faculty	Students	Faculty	Students	
Colorado Agricultural College	97	1280	2	†5	5	†5	0		2	†15	9	†25	†2.7
University of Utah	145	1825	3	†16	3	†14	1	†12	5	†15	12	†57	†4.7
University of Pennsylvania	827	10324	9	150	28	164			20	196	57	510	8.9
University of Southern California	300	4280									8	75	9.3
University of Idaho	90	995	2	32	3	20			3	27	8	79	9.8
Stanford University	370	2132	4	4	13	215	5	5	5	80	27	504	11.2
Carnegie Institute of Technology	364	4060	6	84	6	119	7	55	6	79	25	337	13.5
State College of Washington	172	2532	3	135	10	82	2	26	4	38	19	281	14.8
Montana State College	68	1225	2	96	5	31			3	32	10	159	15.9
Rose Polytechnic Institute	16	237	3	65	3	64			3	29	9	158	17.5
University of Washington	216	7135	6	287	5	125	3	100	19	125	31	637	20.5
Purdue University	226	2955	11	462	14	589			12	350	37	1402	37.9
University of California	[1]626	[1]16620			°14	°677	5	242	10	226	‡29	1145	39.4
Georgia School of Technology	84	2209	5	400	10	390			9	165	24	955	39.8
California Institute of Technology (Throop College)	40	368	2	Data not available	4	Data not available			4	Data not available	10	Data not available	Data not available

†Juniors and Seniors only. First two years all take prerequisite course.

1. The figure in the student column includes registrants in the affiliated colleges of law and medicine. The Berkeley registration is 9882. The figure in the faculty column includes only the regular members of the faculty, it being almost impossible to include the staffs of the affiliated colleges.

°Including Electrical Engineering.

‡This figure includes only the faculty members listed for the four engineering departments. The total of the figures supplied by the University was 183, but included all teachers of courses required of engineering students (i.e., mathematics, drawing, physics, chemistry, geology, mineralogy, hygiene, physical education, etc.), a body known as the "Engineering Council."

ing. Next on the list, and virtually first, comes the University of Pennsylvania with 8.9 students per faculty member, continuing in increasing rates to Georgia School of Technology, which has 39.8 students per member of the faculty, the average of the fourteen being 17.5. It is not necessary to conclude that the universities having the very least number of students per faculty member are best prepared to train their students, as other conditions may enter in which greatly affect the conclusion. On the other hand, it should not be assumed that the universities having the highest number of students per faculty member are least prepared carefully to train their students, as these may be better equipped with apparatus than others on the list.

Increased Engineering Enrollment

Another tabulation is given which shows the rate of increase in the engineering enrollment compared with the total for the whole of the universities and the percentage increase in the engineering colleges. Of these it is interesting to note that six show a much higher rate of increase in enrollment in the engineering courses than in the universities generally, and this is a healthy indication for the electrical and allied industries. As the electrical industry is increasing in scope more rapidly than any other one industry in the country, it is only reasonable that the students preparing to take this up as a life work should increase at like ratio.

A Broader Engineering Curriculum

Within the scope of this investigation it was impossible to investigate and compare the curricula of the various colleges, as each one would require a separate consideration for itself depending upon the needs of the individual student. But in order to collect the ideas and obtain the best advice from experienced men of mature years on the best and most advisable subjects to be pursued, the question was asked if it was found advisable for a student to take a technical course in the more restricted sense of the word, with probably ninety per cent of his time devoted to technical subjects, or to take more general courses; and if so, which courses should be recommended.

Without fail the answers to this inquiry were that the student should not confine himself to a technical course, but should obtain a broad general education along business engineering lines.

Business engineering would be defined as the study of courses relating to trade and market conditions, history, English, logic, mathematics, record keeping, and a procession of subjects directly relating to the particular branch of the industry in which the student desired to become engaged.

Engineers, particularly electrical engineers, for example, may be divided into three classes—detail engineers, such as office men, draughtsmen, and others who are required to work out technical problems

UNIVERSITY	Rate of Increase in Engineering Enrollment Compared with Total for Univ.	Per Cent Increase
California Institute of Technology (Throop College)		
Carnegie Institute of Technology	Much higher	Normal—10% 1919-20—40%
Georgia School of Technology	About the same	75% in 3 years.
Montana State College	Higher	1919-20—30%
Rose Polytechnic Institute	Special increase in Mechanical	
Purdue University	Enrollment limited	
Stanford University		
State College of Washington	Higher than any but Agriculture	
Univ. of California	Lower, due in part to great increase in no. of women in other depts.	33⅓% in 3 years
Univ. of Idaho	Higher	
Univ. of Oregon	(Pre-engineering courses only)	40% in 1 year
Univ. of Penn.	Enrollment limited	
Univ. of South. Cal.	About the same	
Univ. of Utah	About the same	1919-20—60%
Univ. of Washington	Higher	Over 100% in 5 yrs.

along the more theoretical lines; operating engineers, who are required to fill such positions as superintendencies; and engineer executives.

Of the first, those who are qualified as research engineers have all the qualifications of the class just mentioned, and others in addition. The inside engineer is required to spend his time poring over drawings and detail instruments. All large industries require men of this type, who are painstaking in detail and thorough in finish. Such engineers would not be hampered by a lack of the general college training, but could well succeed if graduating from a technological college.

The ranks of the army of superintendents and operating engineers are at the present time largely filled with men who have not had the benefit of university training, but it is conspicuously noticeable that those men who are college trained have made far greater successes in this branch of the work. These are the engineers who come into intimate contact with the operating force of the plant. They are required to supervise the efforts and direct the energies of both trained and untrained workers, and a great deal of human understanding and sound common sense is required of such engineers. It is therefore necessary that men who hold these positions should receive more general training than the inside engineers, although since their greatest experience comes through the school of hard knocks a purely technical course in college would serve as the groundwork for the training to be obtained in actual practice.

The third group is that of the executive engineers. The president, the vice-president, the general manager, or the electrical engineer or the chief engineer of a company may be an engineer executive in that he may have a technical training along the lines of the industry in which he is engaged. He must be able intelligently to discuss technical subjects with salesmen and engineers from his own or other organizations without requiring that these be translated into popular English. He must have so great a familiarity with the technical phases that he can readily absorb the essence of any given proposition without study of the minor details.

In this classification are found the most successful engineers, both from a financial standpoint as well as that of responsible positions, and it is these engineers who require the most thorough business engineering training. Not only must an engineer executive be familiar with technical problems, but he must also deal with market and financial conditions; he must be familiar with the law, so that he is able to draw up or readily understand a legal contract; he will probably be responsible for the purchase of large volumes of material and must be familiar with metals, fabrics and processes which enter into the manufacture or production of the materials utilized.

Other work of the engineer executive is to gather from his subordinates, such as the operating engineers and the inside engineers, the various factors which enter into the solution of a given problem, to digest these and prepare them in such a form as to make them presentable to a board of directors or higher official not versed in the technical phases of the subject. It is therefore necessary that the engineer executive be able to place the most complex technical subject in simple terms, understandable by the non-technical man. To do this requires a study of English, and for such a man it would be better to specialize on general cultural subjects, including the various college courses classified under the general head of English courses, equally with the study of the technical subjects themselves.

Taking as an example one particular branch of the college training which an engineer receives, such as mathematics, and noting its application by the three classes above: the inside man is quite likely to require the use of a great deal of mathematics, and although ninety per cent of his work will be done by arithmetic, now and then it is necessary for him to make use of higher mathematics such as differential and integral calculus; in machine design a great use is made of mathematics. The operating engineer has little need of mathematics. Generally speaking, an operating engineer may do all his mathematics on a slide rule unless his company is of such a small size as to require him to step into the branches of inside engineering as well as executive engineering. The executive engineer has perhaps the least use for the higher branches of mathematics of any of the three classes. One reason for this is that an engineer of this class is in position where it would be useless for him to spend his time performing mathematical feats when a small-salaried man could do equally well.

It is obvious, then, that the qualifications for an engineering career vary widely with the type of engineering finally taken up. As this is frequently a matter of opportunity, of mere chance, or of tastes developed after considerable practical experience, it is safe to say that a well-balanced technical, business and cultural course is the best preparation the university can offer its engineering students.

HYDRO USED FOR TREATING POLES

In a recent article published in the Bulletin of the Ontario Hydro-Electric Power Commission, E. C. Adsett, local manager of the Hydro-Electric Power Commission of Trenton, told how the heating of small wood preserving plants a l'electric instead of by an open wood fire has proved an economy both in labor and in preservative. This is due largely to the low fire risk of the electric element. The practice of brush-treating or spraying poles with hot preservative undoubtedly would be more general today but for the difficulties and risks involved in the heating of the highly inflammable hydro-carbon wood preservatives in a pole yard with no proper facilities for doing such work.

Using the electric element there are the additional advantages that the liquid is kept free from ashes, the apparatus is always ready for immediate use, and no attendant is required to devote all his time to watching the fire. To be most economical, of course, the power should be used "off peak."

The Engineer in the Making

(The engineer is destined to be one of the most important factors in human progress, and it is to the universities that the world is looking for engineers fitted to take the important places awaiting them. Is the engineer's training sufficiently broad? Is it too "practical" or not practical enough? The following symposium gives some interesting ideas on the subject as it is viewed by university-trained engineers.—The Editor.)

What does the university graduate think of the engineering training he received in college? Did it meet his needs when he began to apply it? Does a college education justify itself practically or otherwise? What does the student actually want from college and what does he get? The answers to these and other questions of the same type are of immense importance to the engineer, to the electrical industry, and to the community as a whole.

With a view to obtaining some kind of data on the subject, the Journal of Electricity sent out three questions to a number of college-trained engineers, and received several interesting replies.

More Culture for the Engineer

Almost unanimously these men deplored the lack of general cultural training among engineering students; their inability to write clear and convincing English; their deficient knowledge of history, economics and, in fact, all branches of learning not directly connected with their technical work. In some cases this is considered a result of laxity on the part of the student; in others it is attributed to the nature of the college engineering requirements, which neither include the cultural courses, nor allow the student sufficient leeway to select them for himself.

O. B. Coldwell, second vice-president of the Portland Railway Light & Power Company, writes as follows:

"After all has been said and written on the subject, it will still depend upon the student himself as to what he will get out of his college work.

"In my opinion, the general run of engineering students is if anything a little shy on general culture. In other words, their knowledge of English, history, art and other subjects of the sort is hardly broad enough; I am thinking more particularly of the English. The tendency of the engineering student is often not to take seriously his work in English, with the result that when he gets out into practice, he is unable to write a report in a manner which carries with it the conviction which is usually needed definitely to settle anything. I have come in contact with a large number of engineering graduates and I have found the above to be one of the principal handicaps under which they labor."

In much the same vein Charles W. Merrill, prominent San Francisco metallurgist, writes:

"While contact with business affairs of the world is of importance to the student, I do not feel that it is vital, although I am in full sympathy with a broader university training in the scientific courses than is usually given at a university. Particularly do I believe that economics, history and philosophy might to some extent displace the so-called practical applications, such as drilling a block of granite."

The Commercial Engineer

Another criticism of university training centers around the specialization in highly technical subjects to the utter exclusion of the business side of engineering. J. B. Black, general sales manager for the Great Western Power Company of California, voices this criticism in the following terms:

"I feel today, and have always felt, that too much time is spent in the engineering courses in the university on highly technical subjects which compared with the time they require, are very little, if any, use to the graduate who may be engaged in practical engineering.

For the man who proposes to engage in purely technical activities or research work after graduation, these courses are no doubt quite important. But for the man who takes up any of the various forms of practical engineering or construction work in my opinion they prove of very little use.

Greater emphasis should be placed upon courses in English, economics, banking, business law and practical accounting. As you know, in the ordinary four-year engineering course in the university, very few electives are given and there is a natural tendency for the student to choose the so-called "snap" courses on account of the fact that he usually has about all the work he can take care of in the prescribed courses.

I realize, of course, that it is necessary for any man in engineering activity, to have a thorough groundwork in physics, mathematics, etc., and believe further, that there is nothing quite so effective in fixing principles in a student's mind as viewing or working out practical illustrations.

I have been struck particularly by the utter lack of knowledge of ordinary business problems on the part of the engineering graduate. It seems to me that there is a great opportunity not only in public utility business, but in other lines of engineering endeavor, for the type of man who might be called a commercial engineer.

I have three alternative changes to suggest by which the engineering student may be able to acquire, or at least be thrown in position to acquire, something besides the "bare bones" of an engineering training in the university.

FIRST: Require that the engineering student finish in the high schools, a large part of the work now given in the first year or two at the university. This would release a considerable amount of time in the four-year course which could profitably be devoted to languages, finance and ordinary business education.

SECOND: Do away with the present four-year course and insist on a five-year course which would accomplish the same end as regards the obtaining of increase in time.

THIRD: Set up an entirely new course along the lines of commercial engineering, cutting out all highly technical subjects and prescribing courses in languages, finance and general business education. The present engineering course could be readjusted to take care of students who desire to follow research work, etc. This latter course should be arranged to permit of lectures by men drafted from the business world and should be supplemented by trips to various offices, power plants, construction projects, and so forth."

S. Waldo Coleman of the Coast Counties Gas & Electric Company is another advocate of a broader basis for engineering training:

"In considering the proper curricula in an engineering course it is well first to consider what we expect of the student when he graduates. He has been educated largely at the expense of the state and we should, first of all, expect that he will be a good citizen, and in the university there should have been instilled in his mind a sense of responsibility and a feeling that he should aid in the maintenance and development of a lawful government. The people of the state have a right to expect that in view of his education he shall take the initiative in constructive citizenship.

What we require today are men who THINK, are able to make practical recommendations and know how to accomplish practical things. An engineer to do this must, of necessity, have a thorough grounding in the fundamentals of his profession. He should be able to express himself well in the English language and for his recommendations to be practical (commercially possible of fulfillment) he should have an understanding of general economics, and an idea, even though faint, of banking and business law. Therefore, if necessary, we should even curtail on some of the engineering work, that the student have time to grasp points connected with English, economics, banking and business law.

"Science today, even that connected with any one branch of the engineering profession, is so vast that it is questionable whether highly specialized work in any branch should be attempted during the four-year course. Those who desire to

specialize should be encouraged to take a post-graduate course. If it is considered that the student cannot afford to spend another year at the university, this specialization should be left anyway to the senior year."

Practical Experience

The contention that the university graduate has a purely academic training behind him, and that he is virtually useless until he has had practical experience in the business and scientific world, has led many to consider the possibility of combining college work with outside experience, or at least bringing them into closer contact. In general this idea does not seem to meet with unqualified enthusiasm, Mr. Charles Merrill stating, as quoted above, that the contact does not seem to be vital, adding, however, that "A very short business course, possibly one hour a week for one semester, with a few addresses by prominent business men" would perhaps accomplish the necessary contact.

In the belief that some kind of contact should be maintained between academic and practical work, Mr. Coleman makes the following suggestions:

"Students should be encouraged to work during their vacations in industries for which they are perfecting themselves. It would be well that visits of the students, under the guidance of a professor, be made to industrial plants and public work in the immediate vicinity of the college, and that men noted in their professions be invited to address the students from time to time."

Considering the possibility of combining academic and practical training, C. R. Weymouth, chief engineer for C. C. Moore & Co., writes:

"There is no practical manner which occurs to me of solving this problem. Generally the average student, who is working his way through college, must utilize his vacation for the purpose of deriving the maximum amount of income. Practical work in engineering lines would yield a comparatively small income to the average student before graduation. Those who are fortunate enough to be able to find work in shops, in drawing rooms, or in the field, should do so to the extent that is practicable, but on the whole I think comparatively little can be done with a student until after graduation."

A letter which gives a comprehensive summary of a graduate's views, comes from G. E. Quinan, chief electrical engineer for the Puget Sound Power & Light Company:

"If the engineering graduate is to be something more than a juggler of formulæ and a computer of values; if he is to have equal opportunity with his fellow collegians from the so-called general culture college for active participation in the affairs of life, he must have, in addition to his special training in the fundamentals of engineering, a substantial grounding in the art of self expression and the science of modern business.

In order of relative importance I would place mastery of English first, knowledge of business second and technical training last. The first two are prerequisites to success in any line of work. They are fundamental and indispensable.

By mastery of English I mean the ability to express thought rapidly and clearly—the facile and effective use of language. This can come only from acquaintance with English literature and experience in speaking and writing.

There is general and just criticism of the deficiency of engineers in this respect, and this one lack, perhaps more than anything else, accounts for the failure of engineers as a class to function actively in public life. The engineer is more handicapped by lack of language than other men, because the subject of his thought is often more difficult of expression, requiring a nicer use of words and frequent resort to figures of speech and to analogy.

By no possible process of reasoning can it be concluded that the engineer will have less need of language than men in other professions, and still the engineering curricula of many colleges provide no training in English.

Of almost equal importance is a good working knowledge of the science of business. Business and life today are almost synonymous. They are inseparably intertwined and are mutually interdependent. While engineering has long depended upon business for its fruition, the relation between the two has become so close, that it is clear upon the briefest reflection that business could not exist today without engineering. Not only is engineering vitally necessary to business and our every day life, but it is predominantly so.

With the facts as they are it may well be asked why the engineer is so seldom found at the head of a large business enterprise, and I am convinced that the answer is, lack of training. The curriculum of the engineering college not only provides no business training, but its exactions upon the student's time are so great as to make difficult the gaining of such training, even if its need were appreciated.

By business training I mean a well planned course of reading and lectures on the science of modern business. Prominent among the subjects in such a course should be the economics of business, organization and administration, accounting methods, banking practice and commercial law. The object of the course should be to give the student a working knowledge of business as it is, and not what various theorists would like to make it. The mechanism and established principles of business should be presented with an avoidance of gossamer theories and dogmatic preachments.

While I would rate technical training third in order of importance, it is on the principle that the omission of any essential endangers all. With regard to technical subjects, the engineering curricula today must be criticised for including in the undergraduate course, too much, rather than too little. Let the B.S. degree signify a thorough grounding in principles, and shape the course to that end, leaving the more highly specialized work for postgraduate study, either in the university or in the field. Though one man in twenty may come through a system of forcing, with valuable specialized knowledge and still retain a healthy body and level head, the remaining nineteen are likely to be minus all three. If the university will send out its engineering graduates really equipped in fundamentals, the engineers, her alumni, will rise up in future years and 'call her blessed.'"

Cooperation of College and Industry

The professor's viewpoint, based on long experience with engineers in the making, while approving the opportunities for practical experience, emphasizes the university's special function of teaching broad and accurate thinking, as distinguished from the facts acquired by experience. Joseph F. Merrill, Director of the School of Mines and Engineering at the University of Utah, writes:

"How, and in what, should an engineer be trained?

No specific answer to this question can be given. Tastes, abilities, circumstances, etc., differ widely. A first-class training for Jones may be sadly deficient for Smith.

The problem of engineering education has been, and is, much discussed. Some little advance undoubtedly has been made, but has not progress been much retarded by a failure to recognize the truth stated in the first paragraph above?

There is general agreement on the proposition that the engineering college should place emphasis on fundamentals. But what are the fundamentals? Are they the same for chemicals, civils, electricals, miners, etc.? Here is where agreement is sadly lacking.

But on one proposition there is general agreement, viz.: the colleges have their limitations. Practical training can be more thoroughly obtained on the job than it can be in college. The college has its shops, laboratories and fields, to be sure, and these are necessary for training in fundamentals; but they can never replace the shops and fields of industry as practical training schools in industry. Hence, when a really practical training is wanted along with a college training, it is found that the best thing is for the college and the industry to cooperate.

But whether formal cooperation, as now arranged by some Eastern engineering schools, exists or not, the fact is that some cooperation in the training of engineers does exist between all engineering schools and industry. Engineering students spend their vacations working in the industries, and this vacation work is an important factor in their training.

What kind of course should an engineering college give? What should its content be? Briefly, the course should stress fundamentals, i. e., the basic principles of engineering science,

and leave the details of highly specialized application to graduate or field study. The content should include considerable English, especially composition, speaking and technical writing, cost accounting, business organization and management, industrial relations, business law and current events.

The best that the engineering college can do for its students is to train them to think accurately and to become intelligent with respect to the world in which they live, especially with respect to that field in which they will serve. Possessed of the ability to think and to work, the young engineer has success in his keeping, provided he has learned to live and work agreeably with others."

A great deal more might be said on the subject of technical education, but the incomplete data at hand seems to be in agreement on several important points. While many graduates have specific ideas concerning changes which might be made in the university curriculum, there is a general sentiment in favor of broader culture for the engineer, and also of a recognition of the needs of the non-technical engineer.

Behind the specific criticisms and suggestions, there is an underlying sentiment which recognizes in the university course an intrinsic worth distinct from its so-called "practical" value, appreciating it as a training in habits of thought and study which are fundamentally more important than an accumulation of facts.

The Education of an Engineer

BY R. W. SORENSEN

(The materials of progress and the demands upon technical men are added to or changed with every new discovery. The familiarity with the tools of science, coupled with clear thinking, a broad outlook and considerable general culture must be the basis of the engineer's education is one of the main thoughts brought out in the following article. The author is professor of electrical engineering at the California Institute of Technology.—The Editor.)

Everyone is of necessity interested in some form of technical education. A score of years ago only a high grade engineer could run a gas engine. Now laws must be passed to keep children from driving high-powered automobiles. Two or three decades back a few men of magical ability installed electric lights, repaired electric bells, or talked over a telephone. Today every housewife speaks glibly of ignition systems, spark plugs, batteries, volts, amperes and kilowatts while she makes a necessary repair to a stalled auto along the road, changes a broken iron or toaster cord, or puts a new set of fuses in the cut out.

A generation back, when these things were new, technical colleges were established to teach men the new sciences and their uses, and to inspire them with a desire to search beyond the then known discoveries for ones of even greater value. Annihilation of time and space, on the land, in the air, and under the sea, and cost reduction of life's comforts and necessities are the proof of the pudding. The technical college of our fathers has justified itself, and its works stand as a monument to the romance of our present civilization. The work of father's technical college was after all not so different from that of the other departments of the university, because the small number of technical fundamentals developed and the dearth of adequate technical text books made it necessary to give the scientific student a goodly portion of the orthodox university work if his time was to be properly occupied.

New discoveries have been made one after another, men of science have specialized and become teachers. These teachers love both their work and their students, and have a desire to give to the student the best possible knowledge of the subject being taught. Many of the early scientific laws developed have stood the test and have not been replaced by new discoveries. To obtain time to learn all of these things, what could be more natural than the introduction of more technical courses into our college curriculum to the detriment and elimination of the non-technical courses?

This practice produced, without question, a superior technician, other things being equal, than did the old school. Living as he has at a time such as has just passed, the technical man has frequently been allowed to detach himself from the things of world interest along other lines to such an extent as to cause him real embarrassment at times. This only seemed to make the situation more acute and to cause too many scientific and technical men to serve only where they find a ready welcome for the language of the slide rule and the mathematical equation. In spite of these handicaps today's technical man has met and stood the test.

Those whose business it is to serve as educators in our colleges are earnestly confronted with such questions as these:

1. Is a technical education worth while?
2. Are our technical colleges using the students' time to best advantage in conducting the courses selected?
3. Are the courses provided for in the curriculum such as to give the most advantageous use of the time of the majority of the students in a given course?
4. Should the course be arranged so as to produce skilled artisans in the several professions or should it produce men versed in theory only?
5. Should more than four years of a man's time be devoted to his college work?
6. Are the problems of the technical man of the future to be the same as those of pre-war time, or are they to be different for each generation of mankind?
7. What high school courses give the better preparation for a technical college?

Is Technical Education Worth While?

The other day an engineer of ability and nation-wide reputation said something like this: "Do you know, I think it would be disloyal of me to express my real opinion of engineering as a profession, because it seems to me that from now on, if a technical man is to succeed, he must use his technical knowledge in other lines of business." Some of us know that years ago a patent examiner left the Patent Bureau of the United States Government because he

said "everything had been invented." The world never needed technical inventions as it does today. We are looking for an electric motor that won't burn up, a way to get more than two gallons of fuel for the automobile at one time, a storage battery comparable in performance with other devices, and other improvements too numerous to mention. The whole world is crying for a scientist to give us not only these things but many other devices, and there is no limit except a man's ability to the things he may yet do in the realm of scientific research and invention.

By these tokens our friend was absolutely wrong. Also he was right, for even greater than these problems are some of the problems of social, commercial, and industrial reorganization which must be solved. There is every reason to believe that in these problems the engineer should be foremost. He is trained to analyze and get at the truth by means of cold scientific facts. He has learned that if his analysis of these facts is not correct, he must forever live in the shadow of an enduring monument of concrete or steel, to which the people refer as "an engineer's mistake." The engineer has erred in setting up limitations which have kept him out of this kind of service, but these limitations may all be remedied and the prophecy of our friend will be in part true because some of the great technical minds of the world will be called upon to solve these problems, which even though considered non-technical are none the less susceptible of solution by technical methods. In other words, the war has done much to teach the technical man that technical facts may be presented in languages other than those of the equation and slide rule, and knowing this, he is going to find ways to express his knowledge in these other languages which are better understood by the world in general.

The College Curriculum

There are many things which affect the curriculum of colleges, not the least of which is geographical location, and in all probability no one technical curriculum which would be best for all technical colleges could be selected. It is the opinion of many of our industrial engineers and foremost educators that there has been a tendency to spend too much of the student's time in teaching special subjects and trade tricks, with a corresponding dearth of time allowed for the study of history, English, economics, and other such general studies which every educated man must know something of if he is to find the better ways of applying his technical knowledge.

It is the opinion of the author that our technical colleges should not produce skilled artisans, but should rather produce men well grounded in their knowledge of the fundamentals of science and its application and imbued with the idea of research, rather than perfection of operation. These colleges should be supplemented by institutions in which the skilled artisan may be developed.

Four years seems to be the popular time allotted to a young man's technical education as conducted at present, but there is a far greater call for men who have spent the additional time required for a Master of Sciences degree, than can be filled at the present time. Men who show ability to handle advanced scientific work, particularly of a research nature, should be encouraged to devote five or even six and seven years in getting a thorough preparation to undertake larger scientific problems. On the other hand, the success of the four years technical course has been so well demonstrated as to warrant an entry of the man who has completed one of these courses, into the active industries.

The problems of the technical man of the future are to involve very much the same fundamentals as those of the past and those of the present time, but just as today's problems of radio, automobiles, air craft, etc., are different from the problems of the development of the Morse telegraph, the steam engine, and the locomotive, so will the future problems be different from today's. The man who knows scientific fundamentals, rather than scientific art-craft, and then in turn knows how to tell them to those who do not know them, will, when these changes come about, find it easier to adjust his life to the changes and thereby be of greatest service to mankind.

Summary of Essentials

In conclusion, then, it may be said that the essentials of a technical education are:

The establishment of a set of high ideals and moral and religious standards.

A knowledge of men, and an understanding of the things which make up the life of non-technical humanity.

A mastery of the English language.

A thorough knowledge of scientific and technical fundamentals.

A knowledge of engineering methods.

When all these are said and done we have an engineer.

"An engineer is one who economically directs manpower, and by scientific design, uses the forces and materials of nature for the benefit of mankind."

Appendix

California Institute of Technology is an example of those institutions which recognized the change in times as soon as the war was over, and appointed a committee to determine upon its curricula for the future.

This committee worked hard on the matter for almost a year during which time weekly meetings were held. Advice was sought of the advisory council of the college: John J. Carty, vice-president, American Telegraph and Telephone Company; Gano Dunn, president, J. G. White Corporation; Frank B. Jewett, chief engineer, Western Electric Company; John C. Merriam, dean of the faculties, University of California; Charles L. Reese, chemical director, E. I. DuPont de Nemours and Company, and other men of the technical profession.

The first striking action of the committee was the elimination of the modern language from the required course of every engineering student. This change does not make it impossible for a student to get the languages if desired, but it relieves a large portion of the student body free to devote their time to other things. These other things, however, must be of the general studies mentioned, rather than the technical subjects, more time being required for English, history and current topics in particular.

Each other subject was taken up for discussion and its value weighed as compared to all other subjects desirable and the curriculum made up as seemed best to the committee.

As a result of this work the time of the course was divided as in Column "A" of the following table. For purposes of comparison, in Column "B" there is given a table in which is shown a division of time as determined by averaging the time devoted to these subjects in twenty-five of the leading technical colleges of the United States.

PER CENT OF COLLEGE TIME

Subject	A California Institute of Technology		B Average Twenty-five Technical Colleges	
Mathematics	15.10		15	
Physics and Chemistry	12.10	27.20	12	27.00
English and General Subjects	16.90	(English and languages)		8.00
Economics and Business	4.35			4.00
Mechanics and Hydraulics	9.00			10.00
Freshman and Machine Drawing	4.45			5.00
Engineer Subjects	38.00			45.00

In addition to the regular academic work each student at California Institute of Technology is required to take three hours of physical education work under a competent director.

DELEGATES AT THE PACIFIC COAST CONVENTION

A. I. E. E. Convention at Portland

(This report of the largest A. I. E. E. convention ever held on the Pacific Coast is rich with accounts of discussions which took place on such timely subjects as the design of suspension insulators, hogged fuel, railroad electrification and the power factor correction on distribution systems. A brief account of the sporting activities as well as the entire convention registration list follow the discussion reports.—The Editor.)

Vice-President J. B. Fisken called the Ninth Annual Pacific Coast Convention of the American Institute of Electrical Engineers to order July 21, at the Multnomah Hotel, Portland. The meeting opened with an attendance of in excess of one hundred and fifty which was greater than any of the former Pacific Coast conventions. In the absence of President Townley, Mr. Fisken presided during the convention. Mayor Baker of Portland extended a brief welcome to the delegates and urged that they lend their fullest cooperation to the development of the water powers of the West.

Vice-President Fisken urged that greater efforts be made to point out the benefits that engineers gained by attending the Institute conventions. The public utilities are prone to support other organizations dealing more with commercial subjects than such organizations as the Institute which are for the benefit of the engineers. One reason that such is the case is that the engineers have not maintained their rights.

Secretary F. L. Hutchinson announced that Mr. Fisken has accepted the chairmanship of the sections committee for the coming year, and will therefore continue to exercise a great influence upon the progress of the Institute.

Vice-President-elect Magnusson recalled the fact that this was the centennial of some of the most important steps in electrical history, including the work of Colta, Ohm, Faraday and Henry, who were with one exception university professors. Since that date there has been a decided change in research work and at present it is the exception when a discovery is made within a university, the more important discoveries and developments having been made by the research departments of the large manufacturing plants. Mr. Magnusson was of the opinion that large manufacturing industries could not live without industrial research and manufacturing would not grow without it, therefore since the Pacific Coast is doing little in the way of industrial research, manufacturing industries here will not make the same strides as in the East where the many well known research laboratories are located.

The insulator papers by Peaslee, by Ryan and Henline, and by Peek were read and later discussed together. A part of the first is quoted below.

FACTORS CONTROLLING THE DESIGN AND SELECTION OF SUSPENSION INSULATORS

BY W. D. A. PEASLEE

In the early days of electrical distribution of power the insulator problem was unimportant. The insulator gave more satisfactory service than the rest of the apparatus essential to the generation and distribution systems. As the transmission distances and therefore the economic transmission line voltages increased the insulator problem became more acute. The first attempt to meet the insulation requirements of these higher voltage lines was an increase in the physical dimensions of the lower voltage type of unit. No attention was given at this time to the distribution of the dielectric field or its shape although the laws governing the dielectric flux distribution in such cases were well-known.

The conventional type suspension insulator unit, and also, to some extent, the multi-shell pin type unit, seem in general to be subjected to the types of failures indicated in the following table:

Mechanical Failures

a. Due to the use of materials having widely different coefficients of cubical expansion as in conventional cap and pin construction which causes enormous stress under temperature changes.

b. Due to mechanical overloading.

OF THE A. I. E. E. HELD IN PORTLAND, JULY 21, 24

c. Due to shocks as shooting.
d. Due to lightning and power arcs.

Electrical Failures

a. Actual electrical puncture.
b. Leakage under adverse conditions followed by flash-over and heavy power arc.
c. Due to porosity.

The requirements to be met in the design of suspension insulators may be broadly classed under two headings:

1. The insulator must support the line mechanically with adequate safety factors under the most adverse conditions.

The insulator must insulate the line with adequate safety factors under any electrical conditions not rendering other apparatus on the line inoperative.

The insulator situation today is in a state of constant development and considerable progress may be expected in the near future. Certain recent investigations indicate that piezo-electric effects may be of considerable influence in porcelain depreciation and recent developments indicate that this situation will soon be met in a very satisfactory manner. Also some rather interesting work is being done at present on the solubility of porcelain in water under the conditions existing in the capillary passages connecting the voids of porous porcelain. Investigations are under way using pressures around 10,000 lb. per sq. in. with very high and very low temperatures to accelerate this action and, by means of the microscope, determine from samples of porous porcelain that have depreciated in the field compared with the porcelain subjected to accelerated tests in this manner, to what extent this solubility may be responsible for increasing porosity. The problem of very high-voltage transmission systems is being studied and some new types of insulators made up of rather special porcelain bodies are being developed that will meet this situatioh without difficulty, and by the time there is money available to build any of the large projected extremely high-voltage lines, insulator manufacturers will be ready to meet the problem.

Insulator Deterioration

The subject of insulator deterioration was discussed from the viewpoints of the manufacturers as well as the operators. Many instances were quoted of insulators having been in service from 15 to 22 years and having had only a very small percentage of failures and in some cases no failures whatever. J. B. Fisken gave an instance of a 60-kv. line placed in operation twelve years ago constructed with aluminum conductor which was protected by exceedingly long arcing horns to avoid danger of burning the conductor in case of short circuits. Owing to the shielding effect of these antennae there have been no failures whatever due to the insulators themselves. This is perhaps the first instance of insulator grading by means of antennae shields. M. T. Crawford of the Puget Sound Power & Light Company stated that an installation of Hewlett type insulators had given no trouble due to punctures from the line voltage and only a few failures due to direct lightning strokes. In his opinion the small area of contact between the metallic link and the porcelain was not good practice. However, J. C. Clarke pointed out that the former practice of using steel links had been discontinued because of this and copper links substituted which more nearly conformed to the shape of the slot in the insulators, thereby giving a greater area of contact. Professor Ryan stated that one cause of trouble due to the condition Mr. Crawford had in mind was that the iron ionized and ions were driven into the surface of the porcelain, but that copper was not subject to this.

Shielding

Although the results noted by Ryan and Peek indicate that shielding has a very marked effect upon the reduction of the unit duty of those insulators in a string which are nearest the line, there were those who were of the opinion that an increase in the number of units would be the best solution for the insulation of lines having a voltage of 220 kv. and higher.

According to E. R. Stauffacher, of the Southern California Edison Company, the Big Creek lines will, within the next two or three years, be operated at 220 kv. The problem of line insulation is one which will be determined by field investigation of the different arrangements of insulator strings, number of units, and methods of shielding. The most feasible method of supporting the center wire which passes through the towers appears to be by means of two strings arranged in either V shape or inverted V shape. Professor Ryan will immediately proceed to investigate the various combinations possible for use on this line.

Porosity

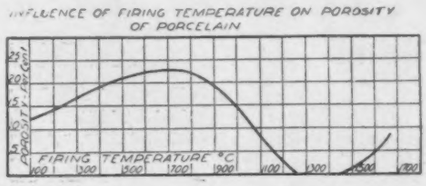
The manufacturers' agents claim that porosity has been entirely eliminated in present day insulators. Mr. Peaslee pointed out that between firing limits of 1250° and 1450° C. porosity was reduced to zero, while above and below the values given, porosity would result. W. A. Hillebrand pointed out that porcelain is composed of three substances, quartz, feldspar and clay. In vitrification the feldspar melts and acts as a binder for the quartz, the clay being decomposed. Vitrification means that the interstices are filled by the molten feldspar—too low a temperature resulting in improper vitrification and too high a temperature causing a formation of nitrogen which caused bubbles. Satisfactory vitrification can be obtained not alone by proper temperature, but must be preceded by uniformity in the processes prior to firing. Within the last five years practically no porous insulators have been marketed.

In the testing of insulators W. E. Hawley of the Locke Insulator Company stated that under a pressure of 13,000 lb.

per sq. in. no penetration of fuchsine dye could be detected by microscopic examination. Mr. Peaslee stated that efforts had been made to determine quantitatively degrees of porosity less than a few hundreds of one per cent, but that efforts had failed to give any results at these low percentage porosities.

Testing

The records of one of the Portland Railway, Light & Power Company lines were given which showed that after two years' service 12% of the units were found defective and after an additional period of six years 7% were found defective.



Curve illustrating results of the fuchsine method of testing porosity, which guards against any errors in raw materials or reading of the pyrometers, that might cause porosity through firing outside of the permissible range.

In these tests all insulators over 100 megohms were left on the line. The testing was done by means of a 1000-volt, 200-megohm scale megger. J. C. Clarke of the General Electric Company questioned the use of meggers such as these in that the resistance of an insulator based on the specific resistance of porcelain should range from 500,000 to 1,000,000 megohms. Professor Ryan agreed with this contention and felt that any insulator meggering less than 2,000 megohms should be replaced.

It was urged that the institute redraw their insulator specifications in order that there might be greater uniformity in the ratings of similar insulators of different manufacture.

In the specification of high frequency testing Professor Ryan showed that the frequency was of probably less effect than the interval between the impulses and the intervals should be specified as well as the frequency.

The effect of vibration upon the life of porcelain was discussed and Mr. Peaslee stated that his tests of impacts on insulators and porcelain samples running into 11,000,000 or 12,000,000 impacts had shown no effects whatever upon the porcelain structure. Providing the porcelain is not stressed to the ultimate limit there appears to be no damage done by any stresses of less magnitude, no matter how often repeated.

Since porcelain contains quartz and quartz displays a very marked piezo-electric effect there might be the likelihood that internal stresses would be developed from this effect. Professor Ryan pointed out, however, that a 1-in. cube of quartz under a tension of 500 volts expanded 1/20th of the length of a wave of sodium light. Inasmuch as a wave of sodium light has a length of 1/50,000 inch, the magnitude of the effect was too slight to cause appreciable mechanical results.

HOGGED FUEL

Discussion of Mr. Corbet's paper on hogged fuel brought out the opinion that as yet hogged fuel is not sufficiently reliable to be used exclusively. According to Mr. Merwin of Portland many interruptions of fuel supply within a plant are due to a breakage on the conveyor system, and the Northwestern Electric maintains heated oil under pressure for quick change-over which can be effected in two minutes. He stated that the oil burned in hogged fuel furnaces gives a lower efficiency than in fuel oil furnaces. The conveying of hogged fuel is usually done by chain conveyors with metallic or wooden flights, although the Northwestern Electric has had good results from belt conveyors two feet wide running three hundred feet per minute at a thirty-degree angle, with the fuel fed in a constant stream on to the belt, sixty units of 200 cu. ft. being handled per hour. Mr. Merwin expressed his conviction that hogged fuel will not ignite spontaneously although the accumulation of fine dry dust must be removed from ledges and walls. An incandescent lamp resting against a dust-covered wall had been known to start a fire.

J. H. Polhemus, general manager of the Port of Portland, stated that on a dredge hogged fuel achieved a saving of $3,000 monthly, and that 10,000 lbs. evaporation per unit of fuel had been obtained. Seven pounds evaporation per hour per square foot heating surface was given as a good performance for hogged fuel.

Mr. Hayward pointed out the possibility of mill refuse coming to be used to produce alcohol, although Mr. Corbett stated that the cost was too great to make it a subject for present consideration.

The opinion was expressed by Mr. Merwin and Mr. Corbet that short, straight grate bars were preferable to any others, and that no difficulty would result from distortion if sufficient supports were provided, and the ash pits flooded to reduce temperature of lower surface grates. Stokers were considered too expensive at the present prices of fuel.

Mr. Corbet maintained that moisture content was independent of climatic conditions, but was entirely dependent on the kind of wood and the treatment before hogging. Some moisture was preferable as extremely dry wood fleshed in furnaces and introduced an undesirable hazard in storage. A mixture of wet fuel with refuse from kiln dry wood gave the best firing results.

RAILROAD ELECTRIFICATION

Much of the discussion of Mr. Beeuwkes' paper centered around the question of standardization of voltage. The general opinion seemed to be that there was at present no basis for standardization. It was thought that 3000 volts was most economical for single track lines, 1500 volts for two-track lines, and for four-track lines even 150 volts. These voltages are such that doubling or quadrupling track would permit of ready cut-over of equipment for lower voltages. Statements were made to the effect that there is no real necessity for standardization between different roads, although locomotives are capable of running nearly one thousand miles without stopping. Mr. Beeuwkes stated that the cost increase in changing voltage from 3000 to 5000 would be greater than the saving of feeder copper for handling 5000 ton trains.

Opinion was unanimous that railroads should purchase power from power companies in that more feed points would be obtainable, and that the comparatively small amounts of power demanded. providing limiting devices were installed, would not be such as to cause excessive peaks on a power system of normal size. Furthermore, the diversity of a railroad load operating at approximately sixty per cent load factor would be very desirable for the power company.

It was held that transmission lines paralleling track should be owned by the railroad, Mr. Beeuwkes pointing out that trolley maintenance crews could maintain transmission lines at minimum additional expense. Mr. Pratt of the Montana Power Company agreed with this but thought the power company should pay for the value of tying their own stations together and for supply to other consumers fed from railway transmission lines. According to Hayward of Vancouver, railway transmission lines should not take the place of transmission busses.

A further argument for railway ownership of transmission lines was that control of switching is thereby retained by the railroad.

According to J. C. Clarke, some Western railroads have maintained that power companies could not accommodate swings caused by heavy trains, but as this is now proved incorrect, these railroads must proceed with electrification to conserve fuel oil.

It was stated that electrification will postpone double tracking for from ten to fifteen years, and that the interest on the second track for that period would overbalance the cost of electrification. Mr. Beeuwkes said that the expense of six months' operation of one division of the C. M. & St. P. Railroad was $113,000 as against $270,000 for fuel, but that any road could calculate exactly the possible savings under any given condition. Comparative costs of train and enginemen expense and wages he gave as 48,000 for electric and 85,000 for steam in six months. The repairs for steam locomotives doubled that for electric locomotives. A further reduction in costs will be effected on the C. M. & St. P. by the installation of automobile substations.

POWER FACTOR CORRECTION ON DISTRIBUTION SYSTEMS

In the discussion of the paper on this subject by D. M. Jones, the opinion was expressed that engineers and operators should encourage the use of the term reactive or inductive factor rather than power factor, as a few per cent reduction of the power factor means a great increase in reactive component. The reduction of power factor from unity to 99% gives an increase of 14% in reactive component.

In some cases power companies charge their customers for low power factor, and in others they assist the consumers to carry expense of installing synchronous motors to raise power factor. The Utah Power Company has installed many synchronous motors in low head pumping plants, and as these have simple starting arrangements they are as easy to put

(Continued on page 142)

Electric Power Consumption, C. M. & St. P. Railway

BY REINIER BEEUWKES

(The economies of railroad electrification are among its most interesting features, and the following details of the distribution and consumption of power on the electrified divisions of the Chicago, Milwaukee & St. Paul Railway provide a valuable compilation of data on the subject. The paper is one of those presented at the A. I. E. E. convention in Portland this month; its author is electrical engineer for the Chicago, Milwaukee & St. Paul Railway Co.—The Editor.)

Power for the electrical operation of the Chicago, Milwaukee & St. Paul Railway between Harlowton, Mont., and Avery, Ida., is delivered to the transmission system of the railway in the form of 100,000-volt, 3-phase, 60-cycle current, and is supplied under two separate contracts, one for the Rocky Mountain Division, extending from Harlowton to Deer Lodge, and the other for the Missoula Division, extending from Deer Lodge to Avery.

The railway transmission line of the Rocky Mountain Division extends from Two Dot substation to the Morel substation, a distance of 184 miles, the former point being 12 miles from Harlowton, the eastern terminus of the division, and the latter point 17 miles from Deer Lodge, the western terminus. Power is delivered by the power company at the Two Dot, Josephine, Piedmont, Janney and Morel substations. The railway transmission line of the Missoula Division extends from Gold Creek substation, 18½ miles from Deer Lodge, a distance of 180 miles, to the substation at Avery, the western terminus of the division.

Substation System

Seven substations on each division are used to convert the 100,000-volt alternating current of the transmission line to the 3,000-volt direct current used for traction purposes. The rated capacities of these stations are as follows:

Substations	Transformers	Motor-Generators
Rocky Mountain Division		
Two Dot	2—2500 kva.	2—2000 kw.
Loweth	2—2500 "	2—2000 "
Josephine	2—2500 "	2—2000 "
Eustis	2—2500 "	2—2000 "
Piedmont	3—1900 "	3—1500 "
Janney	3—1900 "	3—1500 "
Morel	2—2500 "	2—2000 "
Missoula Division		
Gold Creek	2—2500 kva.	2—2000 kw.
Ravenna	2—2500 "	2—2000 "
Primrose	2—2500 "	2—2000 "
Tarkio	2—2500 "	2—2000 "
Drexel	2—2500 "	2—2000 "
East Portal	3—2500 "	3—2000 "
Avery	3—1900 "	3—1500 "

There is an insulated air gap in the trolley in front of each substation separating the trolley system west of the substation from that east of the substation, that is, portions east and west of the substations are fed, respectively, through separate feeder breakers. There is also an insulated air gap at the beginning and end of every passing track, so that by means of a section switch installed in the feeder at the gap the district between any two gaps may be isolated in case of trouble so as to permit operation up to the location of the open switches.

Contract for Power Supply

The terms of the power contracts are similar, and each provides for a minimum payment on basis of a 60% load factor. Where the load factor exceeds 60%, payment is made on basis of the actual kw-hr. consumed, the rate being 5.36 miles per kw-hr. The demand is controlled for each division by means of a so-called Power Indicating and Limiting system, which, on the Rocky Mountain Division, was put into operation early in the year 1918 and on the Missoula Division a few months ago. Briefly, this system is so arranged as to indicate and record at the dispatcher's office at Deer Lodge the total kilowatts or demand being supplied in any instant by the power company to the railway company, and to prevent the maximum demand from exceeding a certain amount as determined by the "demand setting made by the dispatcher," this limiting action being secured by lowering of the substation d.c. voltage and therefore of the train speeds.

The percentage of time when the limiting action will take place will, for a given amount of business, depend on the demand setting and on the possibilities of spacing the trains so that as few as possible will at one time be operating on the heavier grades, the latter matter, except as regards passenger trains and certain time freights, being to a considerable extent in the hands of train dispatchers. The slowing up of the train speeds of course results in increased train and enginemen's expense and increased time in getting freight over the road, and a proper balance must be struck between this increased expense and the saving in power cost, determining upon the limit setting accordingly. The following tabulation will give an idea of the percentage of time the limiting action takes place with average kw. load and settings as indicated, this percentage being based on the number of hours the limiting system was actually in service.

Month	Limit Setting	Avg. Monthly Kw. Actual	Per Cent Time Limiting Action Takes Place
July, 1918	12,000	8,020	13.0
Aug., "	12,000	7,820	15.5
Sept., "	12,000	6,675	8.2
May, 1919	14,000	7,840	4.62
Aug., "	14,000	7,650	4.12
Sept., "	14,000	8,230	9.50
Oct., "	14,000	8,420	10.65
Nov., "	14,000	7,115	8.24
Feb., 1920	16,000	8,625	2.40
Mar., "	16,000	8,680	2.20
Apr., "	16,000	8,620	1.90

Power Consumption for Freight and Passenger Service

In arriving at the amounts chargeable for power against the different respective classes of train service, the total kw-hr. to be paid for, that is, the actual kw-hr. or same increased, if necessary, to correspond to a minimum 60% load factor, is taken and from it is deducted the kw-hr. metered against substation lighting, auxiliary power, signal system supply, etc., amounting to about one per cent. The remaining kw-hr. is then split against the different

Month	Thousands Gross Ton Miles Trailing	Net Kw-Hr. per Thousand Gross Ton Miles —Trailing— At High Tension Bus	—Trailing— At Locomotive	—Train— At High Tension Bus	—Train— At Locomotive	Load Factor	Cost. Kw-Hr. per Thous. Trailing Gross Ton Mi., Cents
FREIGHT SERVICE:							
			ROCKY MOUNTAIN DIVISION				
Jan.	98,478	47.8	36.3	41.2	31.3	63.7	25.7
Feb.	79,859	43.1	27.3	37.3	23.6	57.7	24.0
Mar.	118,297	39.0	29.3	33.9	25.5	65.3	20.9
Apr.	121,646	38.5	25.6	33.1	22.0	61.2	20.7
May	124,395	36.5	26.1	31.7	22.6	56.0	20.9
June	122,264	36.7	26.2	31.7	22.9	56.4	20.9
July	120,723	36.7	23.3	31.6	20.9	55.4	21.3
Aug.	111,092	40.9	27.2	34.9	23.2	54.6	22.4
Sept.	115,787	39.7	25.6	34.1	22.0	58.8	21.7
Oct.	108,920	45.8	29.2	39.4	25.1	60.0	23.6
Nov.	86,267	44.0	29.6	37.7	25.3	50.9	27.8
Jan.-Nov., Avgs.		40.5	27.7	34.8	23.8	57.3	22.5
			MISSOULA DIVISION				
Jan.	87,598	44.3	29.9	38.6	26.1		23.8
Feb.	73,481	39.8	26.2	35.2	23.2		21.7
Mar.	103,613	40.3	25.8	35.6	22.8		21.6
Apr.	109,133	38.5	25.4	34.1	22.4		20.2
May	118,331	37.9	25.1	33.5	22.2		20.3
June	116,660	37.8	25.6	33.3	22.5		20.3
July	106,045	38.1	25.0	33.5	22.0		20.4
Aug.	101,017	38.8	24.6	34.3	21.8		20.8
Sept.	99,578	38.5	25.9	34.1	22.9		20.6
Oct.	100,504	40.0	27.1	35.3	23.9		21.4
Nov.	78,459	45.3	29.5	39.2	25.5		24.3
Jan.-Nov., Avgs.		39.7	26.3	35.0	23.1		21.3
			ROCKY MOUNTAIN AND MISSOULA DIVISIONS COMBINED				
Jan.-Nov.	2,302,507	40.1	27.1	34.9	23.5		21.9
Jan.-Dec.	2,476,085						22.3
PASSENGER SERVICE:							
Jan.-Nov.	340,480	56.8	38.7	39.7	27.1		38.4
Jan.-Dec.	378,080						38.1

These figures are given merely to show the results which are at present being obtained since it is expected that considerable improvement will be effected in maintenance method which will tend to reduce costs.

classes of train service, freight, passenger and non-revenue, in proportion to the total net kw-hr. readings obtained for these respective services from wattmeters installed in the locomotives. These readings are taken by the engine crew on entering and leaving the engine on a form provided for the purpose, and a record of the power consumption of each train is thus obtained. The readings are referred to as "net" readings, as they represent motored energy less regenerated energy.

The ratio of the total net locomotive wattmeter readings, all services, to the total actual kw-hr. input to system chargeable to locomotives for the various months of 1919 and for the whole year is given below:

	ROCKY MOUNTAIN DIVISION			MISSOULA DIVISION		
Month	Actual Kw-Hr. System Input for Loco's.	Net Kw-Hr. Input at Loco's.	Ratio	Actual Kw-Hr. System Input for Loco's.	Net Kw-Hr. Input at Loco's.	Ratio
Jan.	6,381,233	4,838,480	75.9	5,540,581	3,753,430	67.6
Feb.	4,610,607	2,921,840	63.3	4,107,960	2,702,710	65.8
Mar.	5,795,859	4,351,126	75.2	5,412,048	3,469,120	64.2
Apr.	5,949,840	3,962,650	66.6	5,429,932	3,574,080	65.8
May	5,803,455	4,146,517	71.4	5,745,397	3,795,770	66.2
June	5,662,650	4,100,810	72.3	5,697,785	3,853,590	67.6
July	5,744,738	3,794,940	66.2	5,318,692	3,505,630	65.8
Aug.	5,648,815	3,755,280	66.5	5,133,008	3,255,820	63.4
Sept.	5,892,430	3,799,830	64.5	5,102,562	3,434,010	67.3
Oct.	6,222,486	3,971,149	63.8	5,389,883	3,654,955	67.8
Nov.	5,095,937	3,425,458	67.2	4,879,130	3,181,456	65.2
Dec.	5,809,976	3,830,870	65.8	4,971,601	3,382,700	67.9
	68,618,026	46,898,850	68.3	62,728,579	41,563,271	66.3

As there are no wattmeters installed in the direct current side of the substations, a ratio for net substation output to system input or to locomotive input is not obtainable. There are, however, wattmeters in the circuits of the individual motor-generator sets, and the following table will be of interest in showing the manner in which the energy is distributed among the respective substations, average kw. being used for convenience instead of total kw-hr., and the whole of the year 1919 being taken.

ROCKY MOUNTAIN DIVISION			MISSOULA DIVISION		
Substation	*Total Avg. Annual Net	**Per Kw. Input to Motor-Genrs.	Substation	*Total Avg. Annual Net	**Per Kw. Input to Motor-Genrs.
Two Dot	895	813	Gold Creek	1150	1128
Loweth	962	783	Ravenna	915	1115
Josephine	1014	1013	Primrose	908	925
Eustis	1022	1016	Tarkio	843	803
Piedmont	1218	617	Drexel	790	778
Janney	1390	559	East Portal	1390	778
Morel	1047	1072	Avery	812	523
System Total	7548		System Total	6808	

*Total kw-hr. in year; 8856 hrs. being taken, as four days in December are included.

**Total kw-hr. running hrs. of motor-generators.

The figures below show for the year 1919 the net kilowatt-hours per thousand gross ton miles for freight revenue service and passenger service, respectively, and corresponding cost of these kilowatt-hours at the high tension bus or point of delivery of the power to the railway system. The lesser consumption of energy during the summer months as compared with the winter months will be noted. The figure for the passenger service are approximate, as the ton mile data is based on the assumption of an average weight per car, no record of the particular cars handled in the separate trains being available:

1. Cost per Thousand Gross Miles trailing freight as actually distributed in accounts..... 28.8c.
2. Cost per Thousand Gross Ton Miles train freight as actually distributed in accounts 24.9c
3. Cost per Thousand Gross Ton Miles trailing freight on basis distribution in proportion to freight kw-hr..... 30.2c
4. Cost per Thousand Gross Ton Miles train freight on basis distribution in proportion to freight kw-hr..... 26.2c
5. Cost per actual kw-hr. delivered to locomotives..... 1.1c
   The above unit figures include the cost of power.

(Continued on page 145)

Problem Course in Electricity

BY H. H. BLISS

(To be able to make the simple calculations in connection with current and power is an asset even to the electrical man who is not directly concerned with the technical side of the industry. Following is the second of a series of articles aiming to cover this ground by means of practical electrical problems. The author is supervisor of the department of vocational education of Nevada.—The Editor.)

METERING CURRENT AND PRESSURE

Measuring Current Flow.—In investigating the flow of electric current, it is helpful to think of measuring the flow of a current of water, an operation closely analogous. The device known as the "Pitot tube" (Fig. A) is sometimes used for this purpose. Through holes in the wall of a water pipe are inserted the ends of a U-shaped glass tube which contains a liquid slightly heavier than water — say orthotoluidine. One end of the tube points upstream

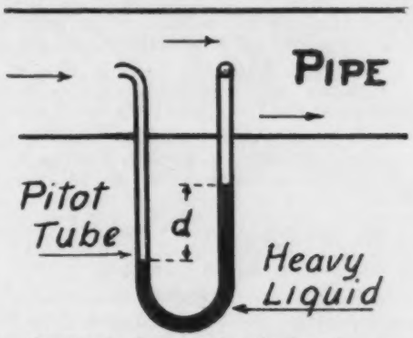


Fig. A.—The "Pitot" tube for measuring the flow of a current of water.

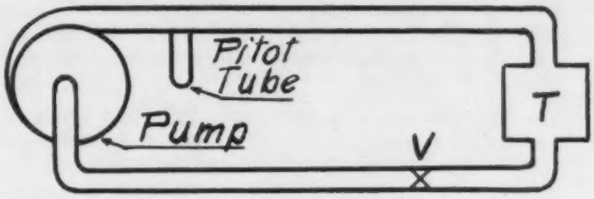


Fig. B.—Pitot tube installed to measure the flow from a centrifugal pump to a turbine.

and the other across the current. It is found that the liquid is depressed in one side of the tube by an amount **d** which depends upon the rate of flow of the water. Hence it is possible to mark or "calibrate" the tube so as to tell at a glance how many gallons per second are flowing in the pipe. This, then, is metering a current of water.

Fig. B shows a Pitot tube installed to measure the flow from a centrifugal pump to a turbine. With the arrangement indicated the water returns again to the pump. Closing valve **V** would stop the flow entirely. The Pitot tube would then read zero, as the liquid would stand level in the two sides of the U.

In Fig. C a generator sends current through an ammeter to a coil of wire when the switch S is closed. If the circuit is interrupted anywhere the current cannot flow, and the meter reads zero. Note that the ammeter, just like the Pitot tube or any other current meter, must be **inserted** in the circuit. To measure a current, then, **open** the circuit and connect the ammeter so that the current must go **through** it to reach (or return from) the apparatus taking current. Different procedure leads to trouble (see Problem 12, below).

Pressure Meters.—For measuring water pressure we make use of apparatus different from the Pitot tube. Fig. D represents the "mercury manometer," one device for this purpose. A glass U tube containing mercury is arranged so that each end opens into one of the pipes connected to the centrifugal pump. The water pressure in the upper pipe forces the mercury down a distance proportional to the excess of this pressure over that in the lower pipe. If the pump stops running and so ceases to generate water pressure, the liquid comes to the same level in both sides of the U.

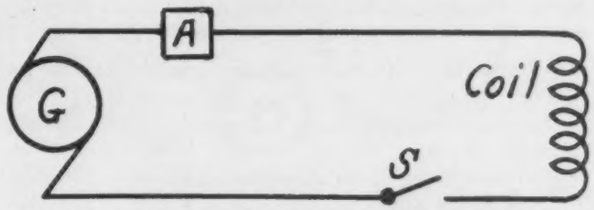


Fig. C.—Showing insertion of an ammeter in an electrical circuit for the purpose of measuring the current.

Another manometer is shown at the right of the same diagram. From its manner of connection it is

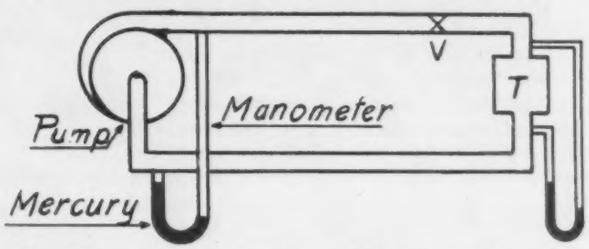


Fig. D.—The "mercury manometer"; a device for measuring water pressure.

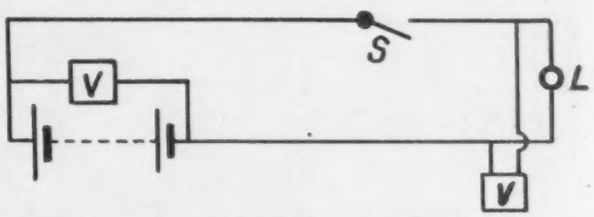


Fig. E.—Diagram of an electric circuit with a voltmeter at the left to measure the pressure produced by the battery, and another at the right measuring the pressure applied to the lamp.

evident that it measures the difference in pressure on the two sides of the turbine, **T**, or what is sometimes called the "head of water" applied to the machine.

If the valve **V** is closed, the flow of water is stopped and the waterwheel ceases to run. The right-hand manometer then reads zero. But the other continues to indicate the pressure produced by

the pump until the latter is stopped. **There may be pressure without flow.**

Voltmeter Connection.—The electric circuit in Fig. E is a very similar arrangement. By means of the voltmeter at the left we measure the pressure produced by the battery, while that at the right tells what pressure is applied to the lamp. When the switch is open the latter, of course, reads zero.

Note particularly that the voltmeter, like the mercury manometer, is connected **across the circuit,** from one line to the other. Voltmeters have high resistances (in many cases thousands of ohms) and hence only extremely small currents pass through them. Ammeters, on the other hand, have very low resistances, often 1/100 of an ohm or less.

Examples.—If the pressure applied to the coil in Fig. C is 36 volts and the ammeter reads 2.5, what is the resistance of the coil? By Ohm's Law: Volts ÷ amperes = ohms; $36/2.5 = 14.4$. What would the meter read if the pressure were increased to 85 volts? $85/14.4 = 5.9$ **amperes.**

What current flows through a 15,000 ohm voltmeter connected across a 120 volt line? $120/15000 =$ **.008 ampere.**

A "mil-ammeter" shows that a current of 37 "mil-amperes" (= 37 thousandths of an ampere) is carried by a 730 ohm resistance. What voltage is applied to it? $.037 \times 730 =$ **27 volts.**

Solutions of Previous Problems

1. Voltage = amperes × ohms = $1.8 \times 2.5 = 4.5$ **volts.**
2. Resistance = volts ÷ amperes = $380/68 = 5.8$ **ohms.**
3. $2 \div 155 = 12.9$ **ohms.**
4. Current = volts/ohms = $120/48 = 2.5$ **amperes.**
5. Voltage = $46 \times .074 = 3.4$ **volts.**
6. Current = $81/2100 = .0386$ **ampere.**
7. Resistance = $220/.27 = 815$ **ohms.**
8. E. m. f. = $.92 \times 3.3 = 3.04$ **volts.**
9. Resistance = $4.1/58.5 = .07$ **ohm.**
10. $6/1.2 = 5$ **ohms;** $6/.86 = 7$ **ohms.** The resistance of copper increases about 40% as the temperature rises from freezing to boiling (32° to 212° Fahr.).

Note: The careful student will in many cases obtain answers slightly different from those presented in the "solutions." For instance, in No. 7 the correct result is 814.814814814 +, but there is no use for such accuracy. 815 is the nearest three figure number. Again, in No. 8 the exact answer is 3.036, but the nearest number that would be read on a meter would be 3.04.

New Problems

11. To measure the resistance of his own body, a man takes hold of the wires from a 12 volt automobile generator. A meter in one of the lines reads .2 of a mil-ampere. What is the resistance of his body in ohms?

12. The new man in a charging station connected a .006 ohm ammeter between the terminals of a storage battery, having mistaken the instrument for a voltmeter. If the battery supplied 9 volts, (a) what current did the meter get (b) what did the man get?

13. Find the reading of a "millivoltmeter" connected to the ends of a piece of metal of .000032 ohm resistance which carries 690 amperes. (This meter reads in thousandths of a volt.)

14. What is the current through the metal when this millivoltmeter reads 40?

15. A certain coil takes .735 ampere from a 108 volt line; find the pressure applied to make it take 8.5 amperes.

16. A 15 ampere fuse blew when a piece of apparatus of 7 ohms resistance was connected to a house circuit. What do you know about the voltage?

17. A 16 candlepower carbon lamp takes ¼ ampere on a 220 volt circuit. If it is connected by mistake to a 550 volt circuit what current would flow providing the resistance did not alter?

18. A 220 volt heater takes 4 amperes on "high heat," 2.75 on "medium," and .86 ampere on "low heat." Find resistance of the heating unit in each case.

19. One terminal of a 240 volt generator is connected through a mil-ammeter to a telegraph wire which is insulated from the ground. When the other generator terminal is grounded the meter reads 6.2. This current evidently leaks through the insulators to the earth. What is the insulation resistance of the wire to which the instrument is connected?

20. In Fig. B, if the valve were open and there were Pitot tubes installed at several places around the circuit, would they all indicate the same current? Why?

21. The resistance of the lamp in Fig. E is 24 ohms; that of the entire circuit outside of the battery is 25.6 ohms. What do the voltmeters read if the switch carries 1.25 amperes?

22. Each of these meters has 2240 ohms resistance. What current flows in each?

This picture of the opening of the Salem office of the Portland Railway Light and Power Company shows how this occasion can be made the excuse for a charming social affair which acquaints customers with employes and the shop and awakens the employes' pride in their new home.

WESTERN UNION TELEGRAM

RECEIVED AT

1920 MAY 30 PM 5 21

A205SF 11 COLLECT

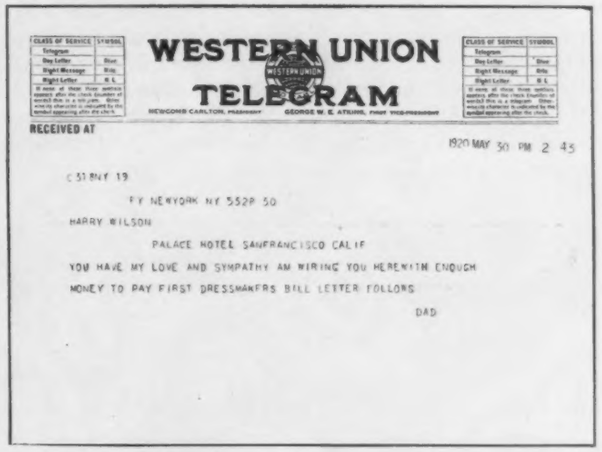
PA SANFRANCISCO CALIF 206P 30

JOHN K WILSON

243 JUNIPER ST NEWYORK NY

HELEN AND I JUST MARRIED WIRE LOVE AND SOME MONEY

HARRY



WESTERN UNION TELEGRAM

RECEIVED AT

1920 MAY 30 PM 2 45

C 51 NY 19

FY NEWYORK NY 552P 30

HARRY WILSON

PALACE HOTEL SANFRANCISCO CALIF

YOU HAVE MY LOVE AND SYMPATHY AM WIRING YOU HEREWITH ENOUGH

MONEY TO PAY FIRST DRESSMAKERS BILL LETTER FOLLOWS

DAD

The answer to the average telegram sent from San Francisco to New York is received exactly thirty-seven minutes after the original message is sent.

Modern Telegraph Service

BY R. B. CALKINS

(The progress of a telegram from the time it is passed over the counter, telephoned to the telegraph company or called for by the messenger, to the time it is delivered to the addressee, is a story of the development of the highest type of efficiency in modern business. This article by an assistant to the general manager of the Western Union Telegraph Company's Pacific Coast Division describes the history of a telegram and the workings of the most modern telegraph office in the world and the third largest in the United States—the new San Francisco Western Union office. —The Editor.)

Between the writing of the first message above and the receipt of the answer, less than an hour later, an almost unbelievable amount of activity has been carried out to get the message through. And this is repeated thousands of times a day. During the Democratic Convention in San Francisco over 4,500,000 words of convention news were sent—in one day over one-half million words. Many comments on the service were given as this was the first convention of the kind to be reported over the multiplex system.

Life History of a Telegram

To make clear the extent and functions of this equipment the typical message shown above will be followed in its progress through the speedy channels. We may read this message conscience-free. It is only "faked;" no one except the operators who send and receive it would otherwise see it.

This wire was filed, let us say, in the Palace Hotel branch office of the company. There the clerk read it back to the sender, counted the number of words, and (if Harry had not needed the money more) would have collected the tolls according to its classification. This particular wire was sent "collect," for obvious reasons, and as the need was urgent it went at the fastest rate —"straight telegram"—or, in telegram parlance, it was a black message. Other Western Union services to meet various needs in the most economical way, are the Day Letter, the Night Letter and the Night Message—or "Blue" "NL" and "Nite" as the telegraph people abbreviate the names.

The Palace Hotel branch clerk immediately put the message in a leather cartridge and slipped it into the pneumatic tube which whisked it under the streets to the main office in the Bankers Investment Building, two blocks away, in fifteen seconds. There it was breathed out on a table on the fifth floor in front of a young lady who opened the carrier, noted that the message was to go to New York and that it was "black." She placed it on a fast belt conveyor which in ten seconds more dropped it in the "New York" compartment fifty feet down the room in front of another apparently unhurried young lady, who immediately set it in a rack at the side of one of the girls who were punching "multiplex" messages for New York. Total time from the Palace Hotel to the New York wire, one-half minute. Here for a moment the demon Speed sits down to breathe, while the motto "Accuracy First" presides over the ensuing operations.

At this point the message entered the most interesting phase of its history—its handling by the "Multiplex." The multiplex system was first conceived, in its crude state, by a Frenchman of the name of Baudot. Baudot had not the technical skill, the engineering staff or the support of a progressive public utility to develop the apparatus beyond the European Government ownership standard, and it was taken up and brought to its high state of present development by the Western Union Telegraph Company. The detailed construction and operation of this apparatus will be described later.

The multiplex operator, using a machine with a keyboard almost identical in appearance with an ordinary typewriter key-board, "wrote" the message just as it appeared on the original message blank except that holes were perforated in a tape instead of letters being written on a sheet. When the machine decided that she had written enough on one line it lighted a red light that warned her to press the car-

riage return key, because she was controlling a receiving typewriter three thousand miles away, and when the message was completed the operator, pausing only to note her number sheet, picked up the next message to continue the steady procession of electric flashes of thought across the continent. At the other end of the line, in the New York office, another type-

Portion of the multiplex section of the operating department

writer-like machine received the message automatically, typing it faithfully—spaces, figures, lines and all—just as it was sent through the holes in the distant tape. It did this at the rate of forty-five words per minute, although it has a possible speed of over sixty-five words per minute. The slower rate was used as there were three other messages going to New York over the same wire at the same time and, in addition, there were four messages being received from New York over that same wire at the same moment—a total of eight messages over one wire simultaneously.

In New York, after the message was received, it was transferred by the rapid-transit belt conveyor to the telephoning operators who called the addressee on the phone and read the message to him—sixteen minutes after his son had handed it to the clerk in the Palace Hotel in San Francisco. Dad wanted to be obliging, recalling his own experience, and when the telephone operator asked if she might take the answer immediately, he dictated it to her while she transcribed it on her typewriter, and, after repeating it back to him to assure its correctness, it was shot up to the New York multiplex operator who started it on its instantaneous 3000 mile ride to San Francisco.

Speed

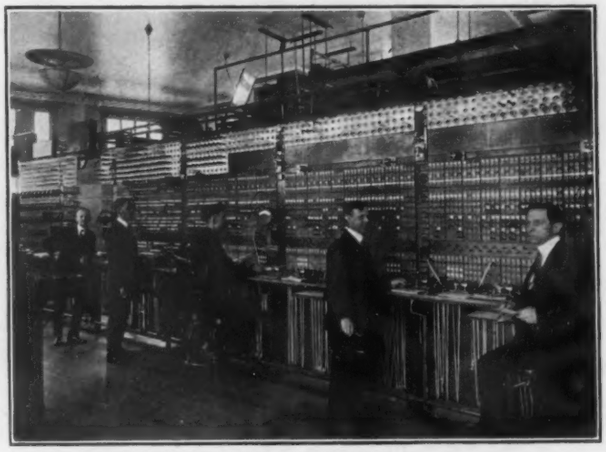
As soon as the multiplex receiving set in San Francisco had ticked off the last word and the signature, the operator tore off the blank from its roll of continuous message forms, endorsed the received time on its face with her electric time stamp connected with a Western Union clock, and after a ten-second ride on the belt conveyor it was put in the pneumatic tube which landed it at the Palace Hotel thirty seven minutes after Harry filed his "S.O.S." Every Western Union "black" or "blue" message—the day-time services—show both filing time and received time in plain figures to the addressee.

Of course this time is not experienced in every case, as some know. Yet messages are being exchanged—sent and answered—between San Francisco and New York within ten minutes every day. The messages are amost literally geared to an inexorable time schedule from the moment they enter the operating room until their transmission has been completed. Out of every 2,500,000 messages—one month's run—2,400,000 go through the tubes, telephone department and belt handling, take their turns at the wires and are completely transmitted and filed away, all within ten minutes total time. The tardy four per cent may take one or a few minutes more. Naturally, when a message is sent on any of the hundreds of direct circuits it is received at the other end at the same instant. It is not merely possible but frequent that a telegram is filed at a branch office and received in New York within fifteen minutes.

Seemingly such speed could not be lowered, but 5000 messages from San Francisco to Los Angeles will show an elapsed time averaging only 7.6 minutes. To Fresno the average time is but 6.1 minutes, to Seattle 7.1, to Portland 6.3, and so on. With instantaneous pneumatic tube service adding but a fraction of a minute and an allowance of four minutes for switching and delivering the message by telephone at the distant office, fifteen minute service from **customer to customer can be comprehended.** The figures given are **averages,** and necessarily include thousands handled within two or three minutes.

The San Francisco Office

The physical plant equipment that makes such speed possible includes not merely the wire lines



Switchboard connecting the various transmission lines to different sending and receiving positions

themselves but also the branch offices—of which there are 30 in San Francisco; the pneumatic tube system—which is composed of 13 miles of 2¾ in. copper tubing, costing $1.20 a foot, laid under the city streets to connect all of the downtown district branch offices with the main office: the main office apparatus itself, and particularly the multiplex equipment.

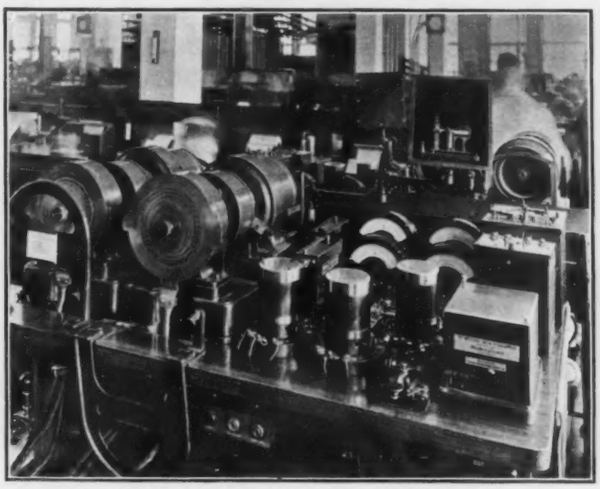
Tube transmission, eliminating all possibility of error and crowding speed to the limit, is the latest and most costly refinement of telegraph practice.

Branch Offices

The function of the thirty branch offices is of course to receive the messages brought into them from the districts in which they are strategically located, transmit these to the main office for sending, and to deliver such as are sent out to them from the main office. Each branch office is the center of a network of messenger call wires which reach into nearly every office in every office building, every hotel and all other public places from which customers may wish to send telegrams. Six thousand of these boxes are in use in San Francisco every day. From these offices the boys go in answer to the calls by phone or buzzer, and here clerks are ever ready to take messages and answer questions regarding service. Daily bulletins and monthly educational meetings keep them always informed of the constant changes in the telegraph situation. An innovation in the larger offices is the typist in the front lobby at the service of any customer who desires assistance in writing his message. Usually it is the busy man who is in a hurry and wants to send a message and retain a carbon copy. The typist quickly types it for him, without extra cost and graciously declining every proferred "fee." Again it is a confused foreigner in a quandary over the preparation of a cablegram to sunny Italy. In cable transmission half way around the world a moderate amount of silence is golden. He is helped to save, to the ultimate word, and goes away a friend forever.

The Pneumatic Tube System

The pneumatic tube system is being completed in San Francisco now, the Market Street section having been hurried to completion in anticipation of the rush of Democratic Convention newspaper "specials." Tubing of pure copper is used to resist electrolysis and chemical action and because it presents an oversmooth surface to the carriers. It is also quite uniform in internal diameter and excellent triple-expanded joints may be made at the ends of the 15 ft. sections, completely preventing the loss of pressure and each of the tubes is closely fitted in a creosoted wood duct. Entering the Bankers' Investment Building at 722 Market street, wherein are the main offices, are 24 trunk tubes. Power for operating these tubes is generated by two 35-hp. induction motors each driving a 14 x 18 compressor. A third unit is to be installed shortly for standby service. These machines operate a combination pressure-vacuum circulating loop system driving and pulling simultaneously, so that the tubes operate under a vacuum of approximately 10 in. of mercury in combination with 5 lbs. absolute pressure, driving the flanged cartridge message containers through the tubes at a speed of 40 ft. per second. The tube system is the exponent "n" in telegraph practice.



Close-up view of the multiplex distributor

A multiplex set; left to right—receiver, transmitter, perforator.

Distribution of Messages

The greatest economy of time is effected in the handling of messages from the time they are shot out of the tubes until they are on the wires. As shown in the illustrations the enclosed belt conveyors traveling 250 ft. per minute interlace over the entire room. Each is driven by its individual motor and every precaution is taken that nothing goes wrong with any of them. In fact there are two men whose only duty is constantly to go around the room, stop each belt in turn for a few seconds, lift it up, look under it to see that no message has slipped out of place, test it to see that it runs freely and then start it again. These are super-precautions: their search is never rewarded by a lost message, and the many checks should prevent one from ever being lost. One noteworthy item is that there is not a single waste basket in the entire operating department—everything is kept off the floor and there are no drawers, desks or pockets. There is in fact no **waste paper.** Everything is messages, and they have only two divisions—completed and awaiting completion. Order is the first law of the operating department, and the visitor promptly gets the impression that a message out of its course would be nothing short of horrifying.

Handling of Local Messages

As the demands of the smaller offices do not warrant the use of the multiplex equipment with its rapacious appetite for telegrams, the traffic to and from them is handled by manual (Morse) operation. Half of the operating room is given to Morse sets, 150 positions being provided. These are divided into "telegeographical" divisions, offices such as Turlock, Merced, Modesto, Fresno, etc., being brought into one aisle. The same operators both send and receive messages, and in order to receive the messages coming to them, amplifying resonators swing close to their ears to isolate each receiving sounder in this modern Tower of Babel.

Messages after being sent, then held in suspense for forty-eight hours, billed and accounted for, are put in the files, hour by hour, and day by day, to be kept for twelve months in case of future inquiry by the senders. Tons of these superannuated telegrams must be destroyed by burning. Nothing but complete incineration satisfies the company's inviolate rule of secrecy for its patrons' business.

The Western Union Multiplex System

A text-book would be required to describe completely the complex apparatus and wiring of the Multiplex equipment and its auxiliary testing and regulating devices. Briefly it might be attempted by explaining that the theory of Multiplex transmission is the apportionment or distribution of the use of the wire to eight different transmitting machines in rotation for equal periods of time—for a very brief instant each transmitter uses the line and in succession the other seven take their turn. The intervals are so rapidly distributed that each machine transmits its individual signals without noticeable interruption, and in fact a transmitting speed of one word per second on each channel is in effect today over Western Union circuits between San Francisco and St. Louis. Between San Francisco and Los Angeles a single wire carries 400 words per minute—50 words in each direction over four channels.

The essential equipment consists of a keyboard tape-perforator, which translates the words of your message into groups of holes in a tape; a transmitting machine which forms series of electrical contacts with the line through the group of holes; and a distant receiving typewriter which receives the impulses in the form of selector signals actuating a type-wheel. At each impulse the type-wheel turns the selected letter-face to the receiving blank and strikes the letter. Between the impulses seven other receiving machines (a total of four transmissions in each direction) are being actuated in the same way. Each transmission is over the same wire, but the individual periods are called "Channels," there being a sending and receiving machine at the ends of each "channel."

The distribution is effected by a rotary "distributor." The face of the distributor, as illustrated is —fortunately for explanatory purposes—the base of operations. The disk is divided into sectors, usually quadrants, each of which represents a separate "channel." The "line" is connected to the distributing brushes which are sweeping over the disks so rapidly that they cannot be seen in the illustration, and they pick up the transmitting impulses from each of the four quadrants in turn as they pass and transmit them to the line. In one whirl of the brushes four letters—that is, their impulses—have been taken from four transmitting machines, shot in equally rapid succession to the line and fed into a receiving distributor at destination which with the same impartiality and composure distributes them in proper order to the four receiving typewriters. Each typewriter operates at such a speed that it is almost unbelievable that the intervals could have permitted the transmission of other impulses to other machines, but to preserve accuracy even at the risk of losing several incredulous readers at this stage,—**four more** messages, not previously heard from, are going over the same wire in the **opposite** direction.

Each segment of the distributor face is further divided into five insulated zones,—one for each of the five perforations in the tape. Metal fingers on the transmitter jump through the perforations where they can, or are blinded and rejected by the absence of holes, and thus a current is or is not passed to the corresponding zone of the distributor segment. If No. 1 hole and No. 2 hole are open, while the other three are not perforated, No. 1 zone and No. 2 zone of this particular channel receive an impulse, while the other three are inactive on this pulse. Therefore these two holes permit these two impulses only to pass over the line into the receiving distributor at the distant end, where by perfect synchronism the brush is then passing over that particular segment, and the combination 1-2 is distributed to the selectors of the receiving typewriter which then combine to select the letter "A" on the type-wheel. If the combination of the second and fourth holes is active and the others passive, the letter "R" is selected and struck on the yellow blank.

Obviously it is necessary for the brushes of the transmitting distributor and the brushes of the receiving distributor to pass the corresponding or mating segments at the same absolute instant, and this is done by a phonic wheel—or tuning forks—at each end, driving the brushes in perfect unison by the energization and de-energization of their propelling magnets.

The perforating machine holds a roll of specially prepared tough paper, 11/16″ wide and 1/500″ thick, the rolls being 250 ft. long—enough paper for 300 average-length messages. The paper feeds out of the machine between the perforating dies as fast as the operator writes, and immediately enters the transmitting instrument. Here another advantage of this Western Union system becomes apparent: the interruption of the wires over a great area, as by a sleet storm, brings Morse operation to a standstill until the re-routing is accomplished, while with the Multiplex the operators can continue to prepare tape, keeping up with all traffic, and when the wires are restored or re-routed the jam is instantly recovered.

In the transmitter (the small box between the perforating and receiving sets) there is a row of five pins engaging the letter holes in the tape and a

central pin operating through the row of drive-holes to conduct the tape steadily through the instrument. The five signal holes form 31 combinations to figures and punctuation which are formed by a prefix-signal operating a new set of selectors, and among these signals there are of course impulse combinations which actuate the carriage-return and paper feed of the receiving instrument. A novel angle of the perforating operation is observed when the operator presses the key which jumps the carriage back to the beginning of a line. So far as she sees the result the tape continues on its way, but she is controlling a typewriter a continent's breadth away, and the signal to warn her of the approaching end of a line is given by the flash of a red lamp.

The apparatus described thus far nevertheless would lack one vital element for practical operation if the operators at either end could not instantly communicate with each other in case of need. A signalling arrangement, therefore, completes the equipment. In appearance and operation it resembles an automatic "Home" telephone signalling device, and gives a choice of five signals, by which the receiving operator, watching the incoming message, can transmit bell signals instructing the sending operator to stop, start, re-run tape, re-punch tape, or call the equipment expert and circuit-supervisor. Should the latter be called in, he can convert the whole complex system into an ordinary Morse duplex circuit by the turn of a switch, carry on a hand conversation with the men at Flagstaff, Albuquerque, Amarillo, Kansas City and Buffalo who have jumped to the wire at the alarm call, and in a few seconds adjust the long circuit, or snap out one set and replace it with a spare, replace the switch and resume normal operation.

Among the famous sayings of famous personages, the old lady's remark that "there ain't no such animal" occupies a classic position. It reflects the feelings of the visitor who finishes an inspection of the Multiplex in operation, but in the end the evidence cannot be denied that it works,—works almost without interruption or trouble, day after day and month after month, carrying 65 per cent of the traffic over the Western Union wires, at unthought of speed and above all, with unmatched accuracy.

Transmission Lines

Entering the San Francisco office are 2000 wires containing the existing working circuits, spare facilities and provision for growth and extension. Wires lead directly from San Francisco to New York, Chicago, Dallas, St. Louis, Kansas City, Denver, Salt Lake, Los Angeles, Portland, Seattle, Spokane, and innumerable other wire centers and local offices on the Pacific Coast.

These wires terminate in a switchboard, which in itself is a thing of beauty to the eye of one who knows and appreciates skillful design and fine workmanship. The operation of the board is by means of plugs and cords which enable the various lines to be connected to different sending and receiving positions.

Personnel

In common with the most advanced ideas and ideals of the larger public service corporations, the Western Union Company has provided well for the comfort and convenience of its operating force. Commodious locker and rest rooms, furnished appropriately, permit the employes to rest and refresh themselves during their hours off duty. Even the messenger boys are adequately provided for with reading rooms, shower baths and lockers.

One particular point, in conclusion, which in a way explains the efficiency of the entire force is the fact that this year sees the beginning of the application of an experimental income sharing plan. After the expenses of operation, interest, maintenance and a fixed dividend are deducted the balance of the income is divided equally between the stockholders and the employes. The scheme of division among the employes is based on their rates of pay, and as the rates of pay are somewhat contingent upon their length of service, this basis is expected to prove highly satisfactory. Life insurance, sickness benefits, pensions and vacations with pay run far into the millions in providing for the 60,000 employes, well repaid by the efficiency of the corps, it is true, but also affording both company and employes, each to the other, the gratification of a broad duty broadly done.

LIGHTING THE FACTORY

It is now a recognized fact that improved lighting improves production. In fact, records show that production increases ranging from eight to thirty-five per cent have resulted from improved plant lighting. And even more significant than this is the fact that this increase has resulted at an increase in lighting cost ranging from only one to five per cent of the pay roll.

Some time ago a representative of the National Mazda Lamp Company prepared the following analysis covering average conditions for a plant employing 100 men. In this case the annual cost of lighting, including everything, amounts to 1.41 per cent of the pay roll. It is felt that this analysis is of particular value to the contractor in securing an industrial lighting contract.

Relation of Lighting Cost to Pay Roll

Initial Cost of Installation		
100 outlets @ $10.00 per outlet, including labor, conduit, wire, etc.	$1,000.00	
100 RLM Reflectors and Ivanhoe Holder No. 822, @ $3.96, less 29%	281.16	
100 200-watt Mazda C Bowl Enameled lamps—$2.30, less 17%	190.90	
Total installation cost		$1,472.06
Annual Operating Cost		
Fixed Charges		
Interest and insurance @ 10%	$ 147.21	
Depreciation on wiring @ 10%	100.00	
Depreciation on reflector equipment @ 12½%	35.15	
Total		$ 282.36
Maintenance Charges		
Lamp renewals	$ 190.90	
Cleaning of units @ $1.00 each per year	100.00	
Total		$ 290.90
Energy Charge (1,000 hours)		
Current @ $0.06 per kw-hr.	$1,200.00	
Total		$1,200.00
Total annual operating cost		$1,773.26
Cost of Labor		
100 men for 50 weeks @ $25.00 per week		$125,000.00

The ratio of the annual lighting cost to the pay roll is the ratio of $1,773.26 to $125,000.00, or 1.41 per cent.

Advertising

BY HOWARD ANGUS

("It pays to advertise" is now a truism, but how to advertise, where to advertise, and what to advertise are still subjects worthy of discussion. Following is the first of a series of brief articles by the secretary of the California Electrical Cooperative Campaign, taking up the question of advertising from the viewpoint of the electrical contractor-dealer.—The Editor.)

The purpose of this paper is not to present an argument in favor of advertising, an argument which is and ought to be unnecessary, but rather to emphasize the more important facts of advertising which electrical contractors and dealers should know and understand.

The meaning of the word "advertise" is to make known, and it embraces all business efforts that make people talk about you and your business, and come

THE SATURDAY EVENING POST
You are entirely safe in accepting the very obvious difference in the way the Liberty rides and drives, as a voucher for quality of the soundest sort.
Liberty Motor Car Company, Detroit
LIBERTY SIX

The above specimen has a number of the hallmarks of good advertising. There is plenty of white space; the printed matter is concise and readable; the name of the advertised article is boldly conspicuous, catching the eye of even the casual observer, and the picture in each case tends to arouse the desire for possession.

to your store to buy. As applied to the retail merchant it means not only to make himself, his business, his location and the goods he sells known to the public, but to keep these continually before the public. If I were to ask any contractor and dealer to give me the names of twenty electrical contractors and dealers, he would name the men he sees the most frequently, knows the best, or hears the most about. The man you seldom see or hear about is soon forgotten. It is the same way with the public; it knows best the store seen most often and heard about continually. The purpose of advertising is just that—to keep your store and business before the public.

Motives for Buying

You advertise for the same reason that you are in business—to sell goods. The appeal must be to the buying motives, which govern people in the purchase of articles. There are five buying motives: (1) Financial Gain, (2) Necessity, (3) Pride, (4) Convenience, (5) Luxury; and the greatest of these are pride, convenience, and luxury.

Let us consider what appeal you have to make as an electrical merchant to each of these five motives.

How many people buy appliances for financial gain, either to make money or to save money? A factory and store owner or any other business man uses electricity for both reasons. But how about the woman in the home? Your appeal to the housewife in behalf of electric appliances from a financial standpoint is in the matter of saving money by the elimination of servants, wash bills, and the like. Inasmuch as most women are trying to make a 1914 salary stretch over 1920 costs, they are interested in anything that saves money. This argument, however, can be used better to offset the cost of an article than as the direct reason for purchasing it. For instance, with the washing machine, appeal is usually made to saving of time and labor. The argument that a woman has against spending so much money for a washing machine is answered by showing her how she can make up the price of the machine on the laundry bills and saving of clothes.

There is practically no appeal to the housewife on necessity. People can get along without electric

Another example of the type of advertising which creates a desire to buy through its suggestion of quality and luxury

appliances, as experience has taught you. They may not be able to get along so well but they can get along, nevertheless.

The buying motives to which the contractor and dealer should appeal all the time are pride, convenience and luxury, and all other appeals should be secondary to these. Stop and think how much these three mean in all purchases for your own home. Why

are you not living like the aborigine, in a tent or a shack? It would save you money and cover all the demands of necessity, protecting you from the elements. You are living in a modern home or apartment because you have pride, because you want convenience and love luxury or the show of luxury. With the woman the home is the center of practically all her dreams and hopes and their foundation consists of pride, convenience, luxury.

Even eliminating the drudgery of housework can be translated into terms of pride, convenience and luxury. Dorothy Blake says, in Electrical Merchandising: "It isn't the drudgery of housework that most women mind, it is the way this drudgery affects her personal appearance and diminishes her charm. Electricity raises her dignity, helps her poise, adds to her charm, and therefore a woman buys electric appliances." The appeal of your advertising as of your selling efforts should be built around the motives of pride, convenience and luxury. Have you been appealing to these three in selling wiring jobs and appliances?

Function of Advertising

The same basic principles apply to advertising as to selling. The four principles are:

1. Gain attention.
2. Secure interest.
3. Awaken desire for the articles or service you have to sell.
4. All resulting in action, or the actual purchasing of the article.

Advertising has largely to do with the first three, that is arousing attention, interest, desire. Their purpose, however, is to bring the people into your store where your salesmen can close the sale and allow you to ring up the money in the cash register. So in all your advertising as in all your sales effort stop to analyze and ask yourself, "Does it catch their attention? Does it interest them? Does it awaken their desire? Will it bring them into the store?"

In all advertising, as in all sales effort, the electrical contractor and dealer is selling a service rather than an article. It is not the washing machine that he is selling but the service that the washing machine will render. It is not the vacuum cleaner, but the service that the vacuum cleaner will give. It is not the wiring job, but the service that the wire will perform in the home. If your sales effort is all spent in describing the article, instead of telling what it will do, in telling all about the wiring job instead of the service it will perform, neither your advertising nor your sales talks will ever get you very far.

In connection with the subject of service you can well employ a slogan that emphasizes this factor of your business. You should spend considerable time in thinking out the proper wording, for it is important. A distinctive slogan of any kind that states a fact about your business is excellent advertising and every contractor-dealer should have one.

For the purpose of this article advertising will be treated under the following subjects:

1. Newspaper advertising and publicity,
2. Direct advertising, that is by mail and personal distribution,
3. By display signs, such as on delivery wagons, in street cars, on bill boards and electric signs,
4. Show windows,
5. Store display.

This paper is not an argument for which form of advertising is the best, because it is the belief of the Advisory Committee of the California Electrical Cooperative Campaign that all forms of advertising should be employed unless the business is so small that the dealer would merely scatter money around and dissipate his efforts. However, he should at least use the newspapers and direct advertising, have an electric sign, a good show window and store display.

The Advertising Appropriation

The first question that an electrical contractor and dealer should ask about advertising is how much money he should spend. The Advisory Committee has recommended, after careful investigation, to every electrical contractor and dealer who has a growing business that he set aside each January 1st, 3% of his anticipated gross business for the incoming year as his advertising appropriation. In other words, if your gross sales for 1919 amounted to $75,000 and you believe that during 1920 your gross sales will amount to $100,000, then your advertising appropriation for this year should be 3% of the $100,000 (not of $75,000), or $3,000. This figure includes and applies to the contracting department as well as all others. The contractor-dealer, as a contractor has goods and service to sell and, therefore, something to advertise. A man starting in business or advertising for the first time logically should spend a greater per cent—approximately 5%.

This recommendation of the Advisory Committee is conservative in accordance with its general policy, and should not be considered as the maximum. In an article that appeared in the Electrical World, Mr. L. B. Gibbs, Supt. of Advertising of the Edison Illuminating Co. of Boston, said:

> "In our minds, in the Boston Edison Co., we feel that we do very little display advertising in the newspapers compared with the size of our business and the territory we cover. I was talking not long ago with Mr. Richards, advertising manager for Jordan-Marsh. I asked him about the percentage of their gross that they allow for display advertising and about some of the different angles of their policies. He said: 'I thould think, in your electrical business, if a store on its own account, or a man running an appliance store by itself, or a central station spent 5 per cent of its last year's gross on this year's advertising, this would be doing very well and would get wonderful results.'
>
> "You will be interested to know that it has been figured very carefully that if you spend $5,000 this year for advertising you will have $4,000 worth of that advertising coming to you next year, and $3,000 the next, $2,000 the next and $1,000 the next. Thus the $5,000 that you spend this year will have pulling power in diminishing ratio through five years, but it won't have that pulling power unless you add to it and keep it alive. So, if you put in $5,000 this year for advertising and $5,000 next year, you will really get $9,000 worth of advertising next year. You put in $5,000 in the third year and you have $12,000 worth of advertising; that is, you secure this effect in your third year if you keep your work going right along. That runs to a certain period and begins to build up again. Therefore a man beginning in business should use 7 to 10 per cent of his gross in advertising. If part of his business is with nationally advertised commodities, he can reduce that 7 to 10 per cent to 5 or 7 per cent in the beginning of his business. When he gets well established he can do very well with from 2 to 5 per cent of his gross, and if he is handling national products he can easily go down from 1 to 3 per cent of his gross."

Electrical Cooperation in Salt Lake City

BY E. H. EARDLEY

(In few branches of the electrical industry is progress more marked and energetic than among the contractors and dealers. Following is an account, by the proprietor of the Eardley Electric Company of Salt Lake City, of the work which is being accomplished by the contractor-dealer association of that city.—The Editor.)

For the past twenty years it has been my good fortune to be connected with the electrical industry. I have seen it grow from very small proportions, during those twenty years, to the commanding position which it now occupies in the industrial and commercial life of our city and state, and of the whole nation. The changes have been tremendous.

Destructive Competiton vs. Cooperation —

Prior to the organization of the present Electrical Contractors and Dealers' Association of Salt Lake City the business was a "hit-or-miss" affair,

Electrical Contractors and Dealers' Association of Salt Lake City, the group including jobbers and representatives of the Utah Power & Light Company. This flourishing organization is a strong influence in the electrical industry of Utah.

and every man engaged in it was considered by the other fellow as an unworthy competitor. Strife, jealousy and unethical methods were the rule.

As a result of the foundation laid by the men in this industry during the last twenty years, and more recently through the splendid efforts of some of our fellows, we have emerged from this chaos and are learning the great lesson of "Live and Help Live."

Our electrical contractors organization of the past has flourished, died, and been resurrected a number of times, but even when the organization slumbered some of its members had faith in its final permanent establishment, with the result that the present organization is firmly founded, and will accomplish its object of raising the standard of electrical contracting and merchandising, and thereby help every member of the industry.

The central station man of today is working in harmony with the other branches of the industry as he never did before. To our own Utah Power & Light Company much credit is due for the foresight they have exhibited in cooperating with the contractor and dealer in the development of the electrical industry.

Our jobbers, men of experience and ability, continue their fatherly interest in our organization, and they, too, are bending every effort toward our success.

Organized Effort —

Our association meets regularly each Tuesday noon for luncheon, and our attendance is nearly 100 per cent. At these meetings we have a regular order of business and a blackboard demonstration, which is led by one or another of our members, as circumstances permit. Diagrams, sketches of fixtures, and methods of cost finding are chief among the subjects discussed, and much valuable information is gained.

The first Tuesday in each month is called "Jobbers' Day," at which meeting the jobbers and representatives of the Utah Power & Light Company also attend. On these occasions the time is generally devoted to general discussion, which discussion is always very interesting and instructive.

Each month there is a "Social Night" to which affair all the electrical men and their ladies are invited. On these occasions there is speech-making, music, dancing, refreshments, and a general good time. Experience has taught us the value of these social gatherings in the promotion of good fellowship.

Better merchandising is one of the watchwords of the new cooperative movement in the electrical industry. Above is shown the interior of the Eardley Electric Company's well-arranged store in Salt Lake City.

We have also entertained many visitors, and in this way try to keep in touch with the "other fellow."

Cooperation is the watchword of the association, and it is being lived up to. This in a measure is the outcome and development of the past few years with us. The old feeling of animosity or disinterestedness has been forgotten, and we are uniting to produce a spirit of good fellowship and a breadth of vision which means success.

A Central Station Opportunity

BY R. W. GODDARD

(Small current-consuming devices constitute an important load in the development of the central station. Following is an idea from a paper presented at the recent convention of the New Mexico Electrical Association, suggesting an opportunity which has been to a great extent overlooked.—The Editor.)

The wide awake central station is always searching for new uses to which electric current may be put. One field but slightly developed at the present moment, but capable of considerable expansion, is that of automobile storage battery charging. Nearly every auto owner of over two years' standing has experienced battery trouble. The reason for the greater part of this is what is termed "local action"

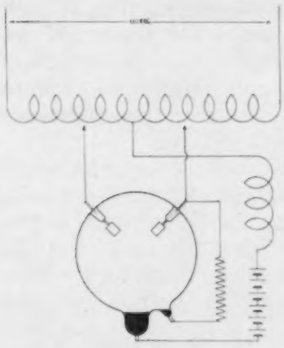


Fig. 1.—Mercury Vapor Arc Rectifier.

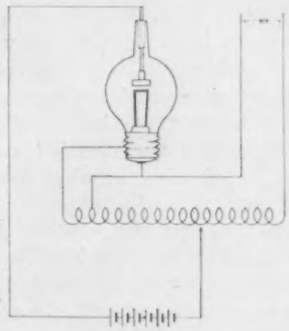


Fig. 2.—Thermonic Vacuum Tube Rectifier.

in the cells. This occurs because of impurities introduced with the addition of water. Since these impurities accumulate as the battery becomes older, this action increases, but with proper charging devices in the hands of every car owner he could, at the necessary intervals, give his batteries extra charges over night without the trouble of visiting a battery service station or laying up his car.

There are on the market devices which are comparatively inexpensive, which will do this. These may be divided into four general classes: synchronous polarity switches, motor-generator sets, mercury vapor arcs and thermionic current tubes.

The synchronous polarity switch is usually a magnetic device which operates a pole changing switch in synchronism with the alternating current source, thus reversing the connections every time the current reverses and giving a unidirectional current for charging the battery. Another device utilizes a synchronous motor which runs a commutator, thus accomplishing the same results as before mentioned.

Motor-generator sets consist of small motors direct-connected to low voltage generators. Years of development have perfected these highly, yet they have troubles caused by their commutators and brushes.

The mercury vapor arc utilizes the peculiar characteristic of the electric arc through mercury vapor between a mercury cathode and graphite anode of allowing current to flow in one direction only. This is due to the ionization of the mercury, which being ionized, has a strong negative charge and thereby electrons will leave it under the slightest voltages. Thus by arranging terminals as shown in Fig. 1, electrons will flow from the mercury to the anode which is positive to it at any instant. Through the cathode circuit the current is unidirectional and may be used to charge batteries. The arc is maintained through the points of zero potential by a choke coil placed in the cathode circuit which makes the current lag behind the potential—lagging power factor—so that before the arc to one anode has ceased, the potential to the other anode has built up sufficiently to establish the flow of electrons to it.

The thermionic current tube is a device utilizing the property of electron discharge through a vacuum from a heated body under electric pressure. Heated bodies emit electrons and the voltage applied will cause these to travel to a positively charged body. Fig. 2 illustrates how this principle is used. Within a glass tube is sealed a filament of tungsten and a

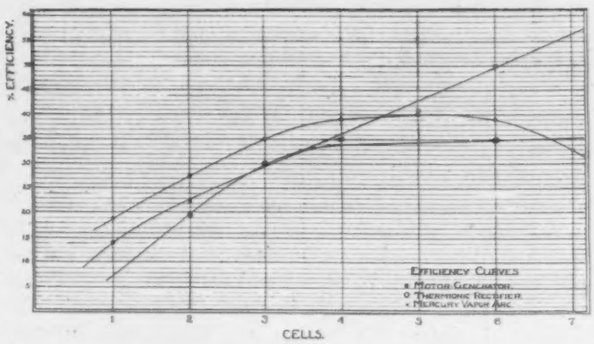


Fig. 3.—Curves showing results of a series of tests run on (a) motor-generator set, (b) mercury vapor arc rectifier and (c) thermionic rectifier.

graphite or metal plate. The filament is heated to incandescence by current from several turns of an auto transformer. When thus heated it emits electrons which travel to the plate whenever the latter is charged positively with respect to the filament. Since the plate is cool, no electrons are emitted from it and, therefore, there is no flow of current in the reverse direction. Thus through the plate circuit a unidirectional current is produced which may be used for battery charging.

For purposes of comparison, a series of tests were run on three standard alternating-current rectifying devices of approximately the same capacity: (a) motor-generator set, (b) mercury vapor arc rectifier, and (c) thermionic rectifier. The results of this test are shown in Fig. 3. The efficiencies run along quite parallel. From one cell they range from 10% to 20% and rise to from 35% to 50% for six cells.

A vigorous campaign on battery charging devices among car owners, similar to the well known flat iron, washing machine and electric stove campaigns, should be decidedly worth while. The load these devices would bring is desirable, being generally off peak, night load and of constant value. The car owners would be greatly benefited by the convenience and greater life of their batteries, and the load of battery service stations would not be decreased appreciably since this home charging would be to a large extent charging that is now neglected.

Steam Power Plant Tests—II

BY H. L. DOOLITTLE

(Following is the continuation of the data on fuel oil economies obtained from extended steam power plant tests. The remainder of the material will be published in the next issue. The author is steam power plant specialist with the Southern California Edison Company.—The Editor.)

Boiler Efficiency —

Tests showed that the boiler efficiency is practically constant between 35% and 130% of boiler rating. Tests in which hot water was fed to the economizer resulted in a low efficiency. Two of the three tests on two boilers fell about 3% below the average efficiency. It was expected that the combined efficiency for two boilers operating on one economizer would be less than for a single boiler operated on the same economizer on account of there being just half the economizer surface available per boiler. It was also noticeable that the tests on the low loads which were made with fewer burners operating, gave better efficiency than those with a larger number of burners. This would indicate that it would be more economical to operate the boilers on light loads with either one or two burners instead of with all four burners.

The tests of the boiler equipped with three burners gave practically the same efficiency as those conducted on the boilers equipped with four burners. It was also possible to obtain the same maximum with three as with four burners. This would indicate that there would be some advantage in having future boilers equipped with three burners as it would make one less burner per boiler to be kept in repair. There is a possible disadvantage in reducing the number of burners, however, in that the four-burner furnace would permit one burner becoming inoperative without reducing the capacity of the boiler or necessitating the immediate installation of a good burner.

A curve showing the combined efficiency of boiler and economizer shows the tendency of the economizer to flatten out the efficiency curve at high loads. This largely compensates for the rapid decrease in boiler efficiency as the load is increased. In general, the economizer adds from 9 to 12% to the boiler efficiency and at the same time increases the boiler capacity approximately 12%.

After conducting the first ten tests on the boiler as originally installed, it was found that the loss in draft in passing over the rear baffle in front of the damper opening was .2" at 140% rating. This had the effect of reducing the available draft on the furnace and thus limiting the boiler output. It was therefore decided to remove the two top rows of rear baffle tile, leaving only one row above the damper opening. After making this change it was found that the available draft was greatly increased thereby making possible much higher loads on the boiler.

Fig. 1 shows the draft required at the damper for the various loads on the boiler after removing the two top rows of the rear baffle. From this curve it is seen that a definite draft is required for a given load on the boiler or for a given amount of oil burned per hour. It is rather surprising to note that the boiler can be operated up to 70% of rating with a positive pressure on the damper.

This positive relation between oil burned and draft required makes it possible to construct a meter which can be connected to the fuel oil lines to the burners, this meter being calibrated to show amount

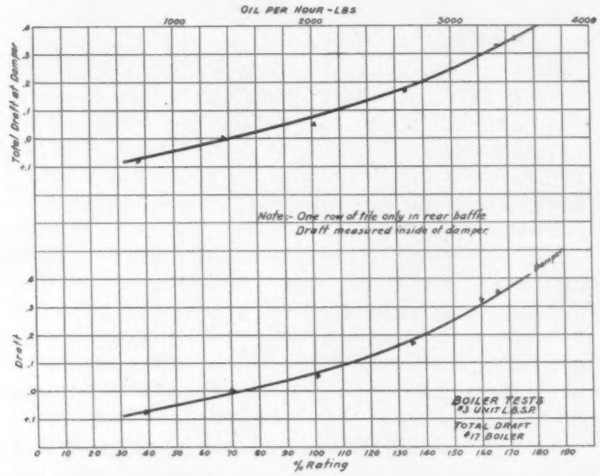


Fig. 1.—Curve showing draft required at the damper for the various loads on the boiler after removing the two top rows of the baffle.

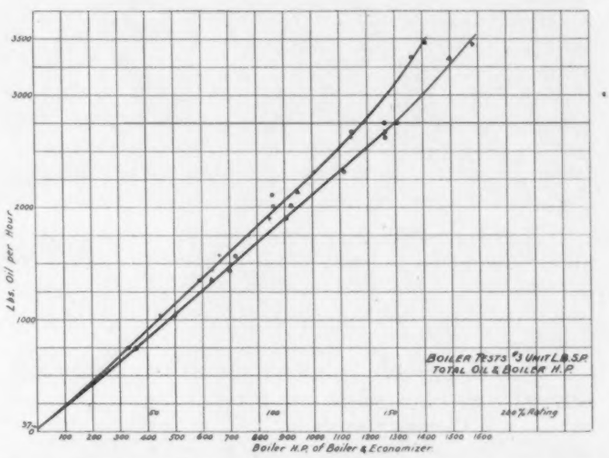


Fig. 2.—Curves showing oil burned for different loads on boiler and economizer.

of oil being burned per hour and also the draft required at the damper. An experimental meter of this sort was constructed and installed and from its operation it would appear that such a meter would be a great help to the fireman in enabling him to operate the boiler with the proper amount of draft. If such a meter were properly used it would undoubtedly result in the elimination of some of the boiler losses due to excessive draft and consequent increase in air supplied to the furnace.

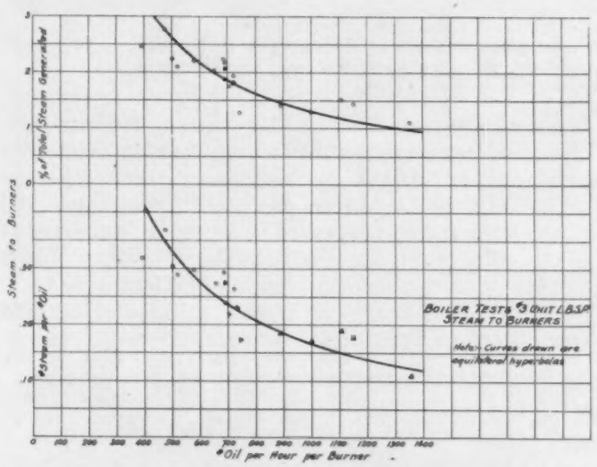

Steam to Burners
#Oil per Hour per Burner
Boiler Tests #3 Unit L.B.S.P.
Steam to Burners
Note:- Curves drawn are equilateral hyperbolas

Fig. 3.—Curves showing the amount of steam per pound of oil fired in relation to the number of pounds of oil burned per hour per burner.

Oil Consumed —

Fig. 2 shows the oil burned for different loads on boiler and economizer. It is seen that these curves are practically a straight line passing through zero between 30% and 150% of rating on the boiler. This, therefore, indicates that the boiler operates at a practically constant efficiency between these loads.

This matter of constant efficiency over a wide range of load has a practical bearing on the operation of the plant in that it would enable the plant to be operated at light loads on several boilers. The boilers would then be ready to pick up additional load on short notice.

Steam to Burners —

The steam used by the burners was accurately measured by means of calibrated orifices, the difference in pressure across the orifices being measured by mercury U tubes. After making several attempts to find some relation between the steam required for atomization and oil burned or the load on the boiler, it finally appeared that the steam required was practically proportional to the number of burners operating.

Fig. 3 was therefore prepared to show the amount of steam per pound of oil fired in relation to the number of pounds of oil burned per hour per burner. The curve shown is an equilateral hyperbola which would represent a constant amount of steam used per burner regardless of the amount of oil burned. It is seen that the points approximately follow this curve. The amount of steam varies from .11 lb. to 1 lb. of oil, when the burner is handling 1400 lb. of oil per hour, to .4 lb. of steam to 1 lb. of oil with the burner handling 400 lb. of oil per hour. From this it is seen that a saving in steam for atomization could be effected by operating the boiler with a smaller number of burners.

Pressure Loss in Superheater —

In order to determine the pressure loss through the superheater a mercury U tube was connected across the two superheater headers and observations were taken at frequent intervals for one-hour periods. Fig. 4 shows the results of these tests and from

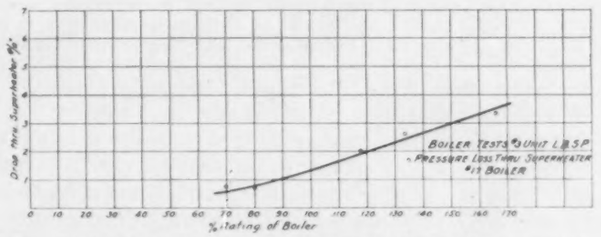


Fig. 4.—Showing results of tests to determine pressure loss through the superheater.

this curve it is seen that the drop across the superheater varies uniformly with the load on the boiler. The drop at 170% of rating was found to be only 3.6 lb. per square inch.

Varying Draft —

Four two-hour tests were made on one boiler operated at a constant load of about 105% of rating. In these tests the total draft at the damper was varied from zero to .3 lb., and the effect of this varying draft on CO_2 and stack temperatures was noted.

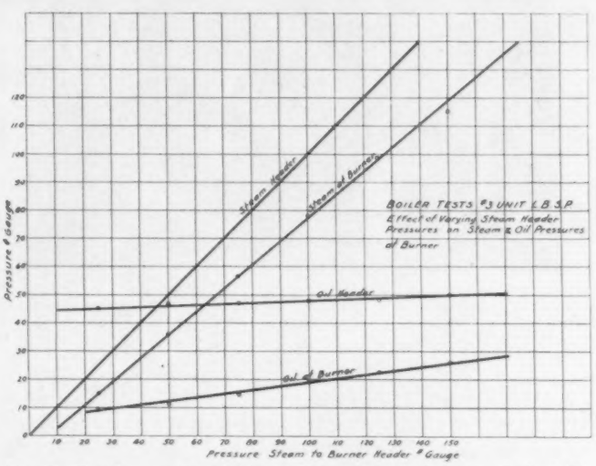

Pressure # Gauge
Pressure Steam to Burner Header # Gauge
Steam Header
Steam at Burner
Oil Header
Oil at Burner
Boiler Tests #3 Unit L.B.S.P.
Effect of Varying Steam Header Pressures on Steam & Oil Pressures at Burner

Fig. 5.—Showing results of tests with varying draft on a single boiler

Fig. 5 shows the results of these tests. From these curves it is seen that CO_2, which is an indication of the completeness of combustion, varies from 8.5% for the .32" draft to 14.7% for the .02" draft. From Fig. 1 we find that the draft required for 105% rating is .07"; this draft corresponds to 13.2% CO_2 from the curves on Sheet No. 8. The average of the CO_2 obtained on all of the tests for the boiler equipped with four burners was 14.0% and for the tests of the boiler equipped with three burners,

13.4%. It is therefore seen that the curve obtained for the tests on varying draft agree very closely with those obtained during the other tests.

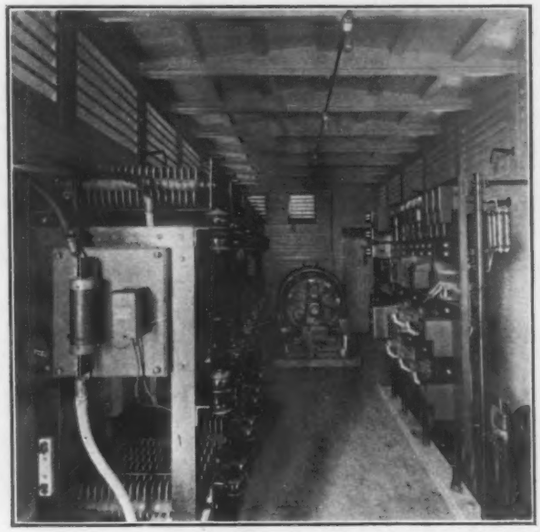
It is also apparent from these tests that the excess air varies directly with the draft. The excess air under normal operation at this load should amount to 20% corresponding to .07" draft. The excess air will, however, be increased to 80% by increasing the draft to .30". This gives a good indication of the unnecessary loss that would result from operating the boiler at drafts greater than those required to give proper combustion.

Automatic Substation, Sacramento Northern Railroad

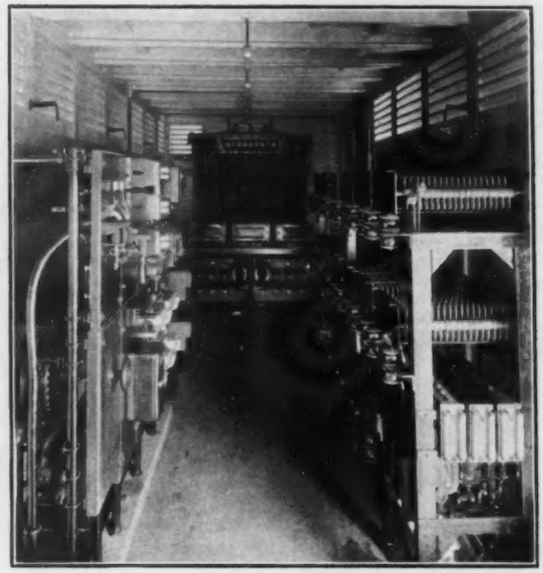
BY W. H. EVANS

(The electrical equipment of the portable automatic railroad substation described here is of interest not only to railroad engineers but also to electrical engineers in all branches of the profession as the use of automatic apparatus is becoming of widespread application. The author is electrical engineer for the Sacramento Northern Railroad.—The Editor.)

Although only the highest type of service can be well tolerated by any public service company, yet there must be certain definite economical relations maintained between the cost of service and the results gained. If the gain in service is not achieved economically the ends will be defeated. If a gain in service may be made with economy, that advantage will be taken. In the case in point, the Sacramento Northern Railroad had been operating its line with substations normally spaced ten miles apart. However, between Sacramento and the first substation north, there were fourteen miles and as the traffic was particularly heavy there the voltage conditions were not the best. The results were slow speed for both freight and passenger trains, and undue heating of motors.



Converter in background is equipped with flash barriers and motor operated brush lifters. Automatic control board to the right and series resistances to the left.



Transformer end of car showing arrangement of louvers to assist rapid cooling.

General Features

To remedy this condition it was decided to install at a point about 5.6 miles north of Sacramento, a portable automatic substation which our figures showed could be installed for something less than $19,000, whereas feeder cable to produce the same voltage regulation would have cost in excess of $40,000.

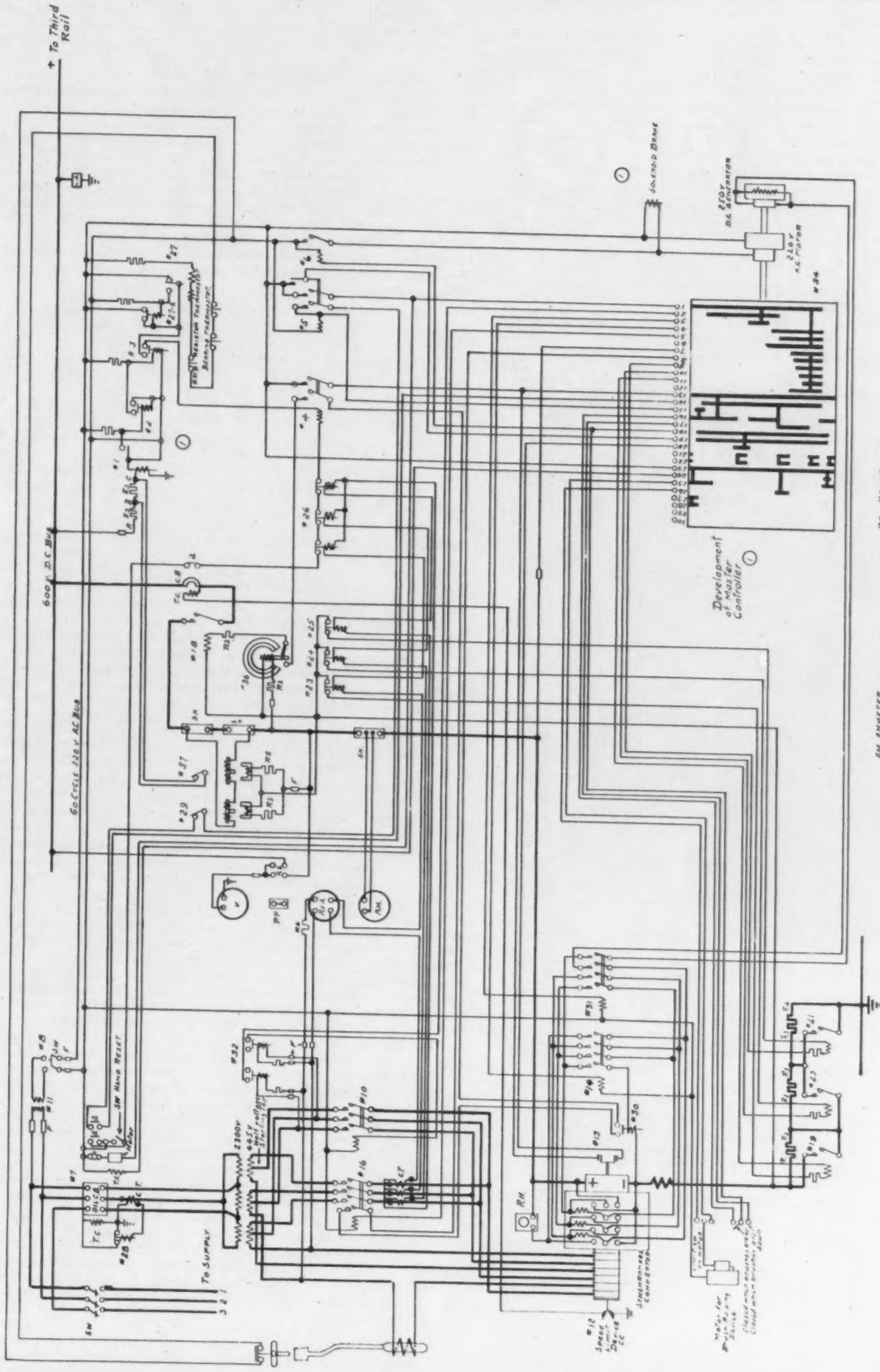
The portable substation consists briefly of a 300-kw., 600-volt, 60-cycle, 1200-r.p.m., 6-phase synchronous converter, a 240-kva., 2344/445-volt, oil-insulated, self-cooled, 3-phase transformer, together with the necessary automatic control equipment. All of this apparatus is installed in a box car constructed in our own shops from an 80,000-lb. capacity, 40-ft. flat car, with the necessary siding and roof added.

Energy is delivered to the railroad's portable substation at 2300 volts, 3-phase, from the power company's 60,000-volt to 2300-volt transformers which are located on a concrete platform which with the pole-top switches and fuses are located inside of a high wire fence for protection against trespassers.

Since the substation is automatic, normally the doors are always closed and locked, and in order to provide ventilation louvers were let into both sides and ends of the car; in addition screened openings are installed in the floor of the car for further ventilation.

Method of Operation

On account of the comparative newness of this type of equipment on the coast, a short description of the sequence of operations which takes place in automatically starting up and shutting down is given here.


To Third Rail
600 V. D.C. Bus
60 Cycle 220 V. A.C. Bus
To Supply
Development of Master Controller
Solenoid Brake
220 V. D.C. Motor
220 V. A.C. Motor
Regulating Resistance
Braking Resistance
Reversing Switch
Line Switch
Main Fuses
Overload Relay
Time Limit Relay
Starting Resistance
Starting Switch
Auxiliary Switch
Interlocking Contactor
Speed Limit Device
Motor for Driving Rotary Converter
Transformer Starting Switch
Transformer Starting Resistance
Transformer Starting Relay
Transformer Starting Contactor

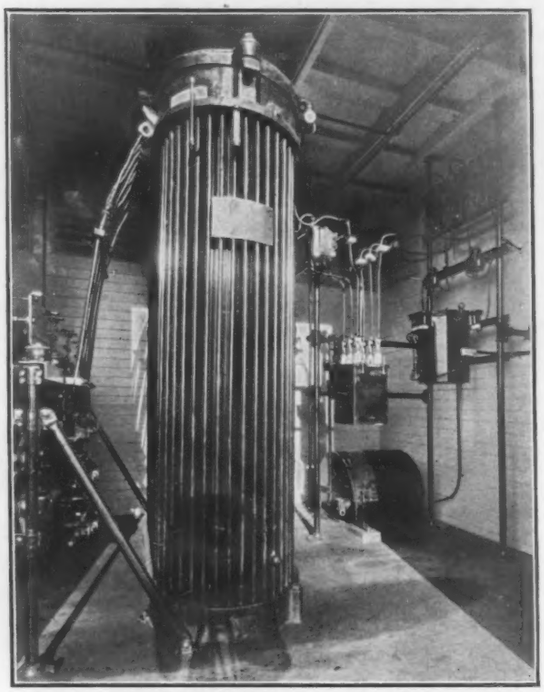
Starting of Station —

With the station shut down, and a train coming into the substation zone on either side, the third rail voltage is gradually lowered until it reaches the value at which the relays in the automatic substation are set which govern starting.

Relay 1 is a contact making voltmeter which is adjustable for any particular trolley voltage desired, in this case 500 volts. In connection with the overload relay 37, which functions to shut down the station, these two relays are the primary control in starting and stopping the station.

Relay one closes instantaneously when the voltage drops to 500 volts, short circuiting the coil of relay 2 which is a time-limit circuit-opening relay whose function is to provide a time delay in starting up the equipment as the low voltage conditions appear, as obviously simply a momentary swing below 500 volts should not be permitted to start up the station; the time setting of relay 2 can be adjusted to suit the particular conditions at any point.

The contacts of relay 2 are normally closed when the station is not running. When relay 1 operates, closing its contacts; relay 2, after a predetermined time, opens its contacts and permits the coil of relay 3 to be energized. Relay 3 then closes its contacts and control current from the 5-kw. auxiliary-control transformer is admitted to the control circuits of the station. A circuit is then established from the a.c. control bus through the contacts of relay 27-X, the contacts of relays 3 and 26, operating coil of relay 4, auxiliary switch on circuit breaker and hand reset switch on oil switch motor mechanism back to control bus. The closing of contactor 4 establishes a circuit from the control bus through one of its contacts to segment 13 on the controller, then to segment 16 upper contact of auxiliary switch on brush raising device, and to the operating coil of contactor 6 and back to the control bus.



Near view of 240-kva. starting transformer, motor operated oil breaker and 5-kw. control transformer.

Operation of Controller —

Contactor 6 closes and starts the motor driving the controller which is very similar to the ordinary type K street-car controller. Through its various contact fingers and segments the controller performs the necessary sequence of operation of the various switches in starting up and shutting down the station, each succeeding step, however, being checked electrically by means of various relays to insure that the electrical and mechanical conditions have been properly fulfilled.

Segment 15 on the controller closes the operating coil of contactor 5 which establishes a circuit through one of its contacts to segment 1 on the controller and simultaneously completes a circuit from the same contact to the closing circuit of the oil-switch motor mechanism.

The oil-switch now closes, energizing the power transformer, and if the proper a.c. voltage exists on all three phases of the low tension side relays 32 close. These relays are so connected that no further operation can continue unless the proper phase voltage exists. Segment 14 on the controller then makes contact, completing a circuit through the auxiliary switch on the oil circuit breaker, one of the contacts and the operating coil of 5. This operation thus establishes a holding circuit for contactor 5 as soon as the controller advances beyond segment 15. Segment 2 on the controller then makes contact, completing a circuit through the contacts of the relay 32 and the operating coil of contactor 10.

Start of Converter —

The starting contactor 10 now closes, placing reduced voltage from the transformer upon the slip rings of the converter which starts. If the converter has come up to synchronous speed by the time the first gap in segment 16 is reached, a circuit is established from segment 14 through the contacts of 13 to segment 20 and thence to segment 18 and the operating coil of contactor 6. This holds contactor 6 closed until the gap in segment 16 is passed. If the converter has, however, not come up to speed by the time the gap in segment 16 is reached the circuit to the operating coil of contactor 6 is broken and the controller now comes to rest until synchronous speed on the converter is reached; i. e., until the speed control switch 13 has closed its contacts.

Segment 3 makes contact, closing the circuit to the operating coil of field contactor 31. This closes and connects the fields of the converter to the 250-volt exciter on the controller, thus fixing the proper polarity on the converter, and as the converter is brought to the proper polarity, the polarized relay 36 closes its contacts. Segment 3 then breaks contact, opening contactor 31.

Segment 4 makes contact energizing the operating coil of full-field contactor 14, which closes and places the field of the converter across its own armature for self-excitation. The field contactors 31 and 14 are mechanically interlocked so that 31 must open before 14 can close.

Running Conditions —

Segment 2 breaks contact, opening the starting contactor 10 and the segment 5 makes contact energizing the operating coil of running contactor 16 which closes and puts full a.c. voltage on the slip rings of the converter. At the same time relay 30 closes due to the establishment of full voltage across the armature of the converter.

Segment 26 makes contact, establishing a circuit through the upper contacts of the limit switch on the brush raising device and starts the motor of this device, thus lowering the brushes down upon the converter. If the brushes reach their lowest position, and the lower contact of the auxiliary switch on the brush raising device is closed, before the controller runs off the second gap in segment 16, a circuit is established from segment 17 through the lower auxiliary switch of the brush raising device to the operating coil of contactor 6, thus holding 6 closed and permitting the controller to continue to revolve. If the controller runs off segment 16 before the brushes are in their lowest position the operating coil circuit of 6 is opened and the controller stops until the lower auxiliary switch on the brush raising device closes and completes the circuit from segment 17 described above. The above steps insure that the brushes have been properly lowered upon the converter.

Segment 7 makes contact giving d.c. potential to segments 8, 9, 10 and 11. Segment 8 makes contact, establishing a circuit through the contacts of polarized relay 36, the contacts of relay 30, the electrical interlock on contactor 16 and the operating coil of contactor 18. Contactor 18 now closes, connecting the converter to the bus through all three sections of the load limiting resistance. The converter is then feeding the line through the 0.75 ohm series resistance.

Segment 9 makes contact establishing a circuit through the operating coil of contactor 21 and the contacts of relay 25 and, if the current demand is below the overload setting of relay 25 contactor 21 closes short circuiting section R-3 to R-4 of the resister.

Taking Load —

Segment 10 makes contact, establishing a circuit through the operating coil of contactor 20 and the contacts of relay

24 and if the current value is below the setting of this relay 20 closes, short circuiting the section R-2 to R-3 of the resistor. In a similar manner, segment 11, making contact, closes a circuit through the operating coil of 19 and the contacts of relay 23, thus cutting out the last section of resistance. The machine is now connected directly to the bus and delivering load. During the last several operations mentioned above after contactor 18 closed, the contacts of relay 37 open, inserting the section BC of the resistance in series with the contact making voltmeter 1. Simultaneously the voltage on the bus has been brought up to normal but the contacts of the voltmeter still remain closed due to the resistance BC which has just been inserted.

Segment 17 breaks contact opening the circuit previously established through the lower contacts of the brush raising device and the operating coil of contactor 6 which latter opens and the controller comes to rest at the running position, being stopped immediately by its solenoid brake.

Shutting Down —

When the load demand decreases and reaches the setting of relay 37 which in this case is adjusted for 100 amperes, the contacts of the latter close short circuiting section BC of the resistance in the coil of the contact making voltmeter 1 causing the voltmeter to open its contacts. This removes the short circuit from coil of 2 closing its contacts instantaneously and short circuiting coil of relay 3 which starts to open its contacts. If the load does not increase long enough for 2 to reset at any time during the setting of the dash-pot on relay 3, the latter's contacts open, interrupting the circuit of contactor 4. Should the load increase before contacts 3 have opened, 37 would open, inserting resistance section BC and causing the voltmeter to make contact. The voltmeter contacts short circuit coil of relay 2. Contacts of relay 2 open after time-delay and re-energize 3.

After 3 has opened, contactor 4 opens, interrupting two circuits simultaneously; the first being the a.c. supply to controller segment 13 and the other the d.c. circuit including the operating coil of contactor 18. The holding circuit for contactor 5 through segment 14, the auxiliary switch on the oil circuit breaker and the contacts of 29, are broken and line contactor 18 and control contactor 5 now open.

The opening of contactor 5 interrupts the supply to segment 1 on the controller and establishes a circuit through its electrical interlock to segment 19. Contactors 16 and 14 open disconnecting the converter from the transformer and discharging its field which in turn drops relay 30 out.

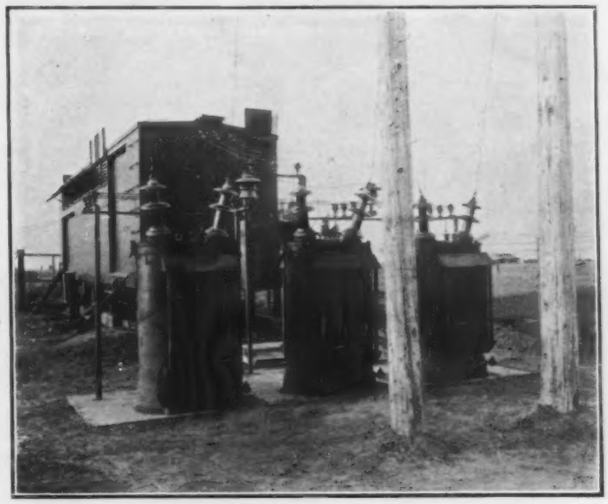
The operating coil of contactor 6 is then energized through the electrical interlock on contactor 5 and segments 19 and 18. The controller motor starts and contactors 19, 20 and 21 open. Segment 24 makes contact energizing the trip circuit of the oil switch mechanism; also segment 25 makes contact through the lower limit-switch on the brush-raising device. The high tension line is now disconnected from the transformer de-energizing relays 32 which open, and the brushes are raised from the commutator. Segments 18 and 19 break contact, and the controller comes to rest at the off position. In the meantime the motor of the brush raising device continues to operate until reaching the end of its travel when the lower limit switch is opened, breaking the supply to the motor. As the voltage on the converter armature dies down after contactors 14 and 16 are open, relay 30 also opens, and the station is completely shut down.

Protective Features —

D.C. Overload.—Relays 23, 24 and 25 are calibrated at a.c. loads corresponding to d.c. loads of 900, 1200 and 1500 amperes and upon reaching these successive loads the series resistances of 0.15 ohms, 0.25 ohms and 0.35 ohms are inserted in circuit with the converter, causing a reduction in the trolley voltage supplied to the third rail and consequently reducing the ampere output of the machine.

A.C. Overload.—Should trouble develop on the d.c. side of the converter inside the connection of the load limiting resistance, relays 26 are energized from the current transformer on the low tension side and will open after a set time and shut down the equipment. Relays 26 are set at a higher value than relays 23, 24 and 25 and are also time-limit opening. This time-limit feature allows momentary swings to occur without shutting the machine down. In our case these relays 25, 24 and 23 are instantaneous circuit opening and time-limit circuit closing being adjusted to close at 3 seconds and at 16 seconds after the current has fallen to a certain value for each relay. This time delay permits of the acceleration at a low voltage of heavy trains which when starting up cause the resistance to come in, and when the trains have accelerated and the current demand fallen off, the time setting permits of their receiving full voltage at the end of their accelerated period.

Additional a.c. protection is provided by relay 28 which is energized from a current transformer in the high tension winding and is set considerably higher than the other overload devices. When this relay operates, the oil circuit breaker is tripped open and with it the hand-reset switch thus completely shutting down the station. The opening of the hand-reset switch interrupts the coil circuit of contactor 4 and simultaneously with it the opening of the auxiliary switch on the oil circuit breaker interrupts the holding circuit of contactor 5. The operation of either of these devices shuts down the equipment. After the oil circuit breaker has been tripped in the above manner and the hand reset switch opened, the station will not start up again until the hand reset switch is closed by the inspector. Consequently relays 28 are set very high and are expected to operate only in cases of severe trouble where the attention of an inspector would be necessary.



60,000 to 2300-volt transformers provided with external, separate pipes for natural cooling of oil are an unusual design.

Low Voltage.—Relay 27 provides the a.c. low voltage protection. When low voltage occurs, the left hand contacts of 27 are closed, short circuiting the coil of 27-X, opening it and interrupting the supply through the contacts of relay 3 to the coil of contactor 4. Relay 29, in a certain sense, performs the functions of an a.c. low-voltage relay whenever the converter is running, since, should the a.c. voltage fall too much, the converter would invert and supply power from the trolley to the a.c. system. Reverse-current relay 29 would then open, interrupting the holding circuit of contactor 5, shutting down the machine.

Over Speed.—Speed limit device 12 on overspeed closes the circuit of the shunt trip of the d.c. circuit breaker. When this opens, the auxiliary switch on the circuit breaker interrupts the supply to the coil of contactor 4 and the equipment shuts down. When this happens it must be hand reset by the inspector.

Under Speed.—The speed control switch 13 is a centrifugal device, the contacts of which remain open until approximate synchronism is reached.

Sequence.—The sequence of events is fixed primarily by the controller but in addition to this there are electrical interlocks on contactors 5 and 16, as well as the holding circuit of contactor 5, all of which are additional safeguards against incorrect sequence.

Polarity. — The 250-volt excitation generator, direct-connected to the motor of the controller, fixes the polarity of the converter, but as an additional precaution the polarized relay 36 must be energized in the proper direction before allowing line-contactor 18 to close.

Temperature.—Should the load-limiting resistance or bearings overheat the thermostats will open de-energizing relay 27 which, when de-energized, closes the left hand contacts of 27 thus shutting the equipment down. The thermostats over the resistor are self-resetting when the resistor cools off, while those on the bearings of the converter are hand reset and require the attention of the inspector before the converter will again start.

A thermal relay is provided whose rise in temperature is proportional to the heating in the converter winding and

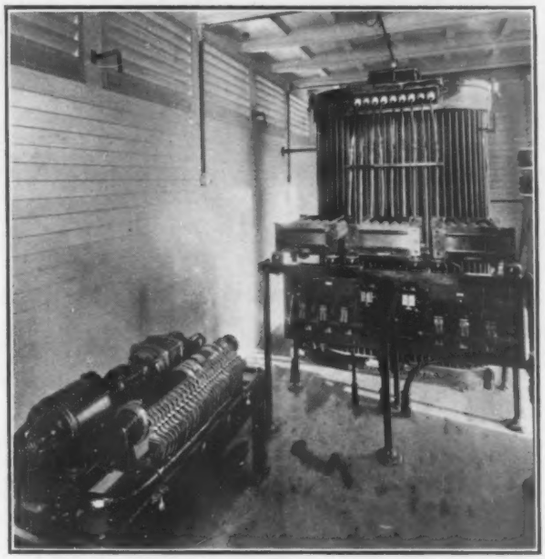
in case of a long continued overload which would injure the insulation, this relay operates and shuts the station down. This relay in one of the illustrations is shown mounted on a small panel supported on the resistor grid iron framework.

The thermal element is the fuse like object connected in one phase of the converter transformer, secondary. A small tube containing a volatile liquid connects from the thermal element to the relay on the right—the expansion of the liquid under heat actuating the relay whose contacts when opened, interrupt the circuit to relay 27 and shut the station down.

Balanced Polyphase Voltage.—This protection is provided on the low tension side of the power transformer by means of the two relays 32 which are connected across different phases. All three phases of the power transformer must be excited to approximately normal voltage or otherwise one or both of these relays will remain open and prevent the starting contactor 10 from closing.

Position of Converter Brushes.—Proper position of these brushes is assured by means of the auxiliary switch on the brush raising device.

The converter is equipped with flash barriers which completely surround the brush holders and in case of an attempted flash-over between brushes the hot metallic vapors are



Starting grids, running contactors and motor operated drum controller.

scopped up from the commutator and dissipated in two sections of wire mesh. The system is subjected to frequent short circuits between the third rail and traffic rail, owing to sectionmen dropping tamping bars across the conductor rail, and from various other causes, so that flashovers on the commutator of the motor generator sets have been quite frequent and severe. These flash-overs were usually accompanied by a spill-over to the pedestals of the machines and it has been found necessary to remove the grounds from the machine frames in order to reduce this spilling-over. There has been during five months' operation of the automatic substation, what was evidently a severe short circuit on the third rail in the immediate vicinity of the substation; the flash barriers no doubt took care of the resulting flash-over at the commutator, some of the flash-screen metal having been vaporized, but the substation cleared itself and when the writer visited the station that day the machine was carrying 50% overload without any evidence of the flash-over having inconvenienced the converter as far as normal operation was concerned. It was evident, however, that a spill-over had taken place to the pedestal of the machine. These spill-overs are believed to be due to the inductive kick occasioned by the sudden extreme variation in current in the third rail, the magnetic effect of which accentuates the short circuit conditions on the machine commutators. In addition to removing the ground from the machine frame an electrolytic lightning arrester has been connected between the positive of the machine and the traffic rail with the belief that the arrester will take care of any extreme inductive kick occurring across the converter armature, the fields, or the series resistors of the machine.

General Results of Operation

Our experience so far with the automatic control seems to show that this type of equipment is particularly advantageous for interurban service. The cushion of resistance which is introduced in extremely heavy demands results in much better operation than the manually operated stations, in that improper handling by a motorman of his train, or in case of two or more trains pulling on a station, does not result in opening the station breaker, with the resultant slowing down of trains and probability of again pulling the breaker when the station operator closes his switches. With automatic control, there is no breaker to open. The station simply cuts in the proper resistance which should have been cut in on the train by the motorman if he had handled his train properly. The voltage to the train is thereby cut down and a lower current demand follows; but in the meantime the train continues to accelerate under this reduced current and in a few seconds the amperage falls to a value which allows the resistance contactors to again close, short circuiting the resistors and delivering full voltage to the trains.

This method of operation naturally results in better conditions as regards flashing at commutators of car equipment due to poor handling of trains as the station resistance automatically takes care of any such defective train operation. For those interurban lines which operate heavy freight trains the automatic control with the current limiting resistors and particularly in combination with a 200% overload characteristic in the converter or motor generator set, is particularly fitted for handling this class of service.

Improved Operation

In addition to the large saving in operators' wages which the automatic control gives, it also provides a considerable saving in eliminating idle running of a substation, with its attendant running-light losses. Substation operators are instructed to cut in or off the line either at defined time intervals or upon certain current and voltage indications upon their station instruments, but we are aware that even under these regulations there is a very considerable amount of idle running. Under automatic control, however, running-light losses are cut to a minimum as the station does not start except upon a predetermined demand for power and then shuts down when this demand no longer exists. The greater the interval between trains, the larger will be the saving of energy obtained through the elimination of running-light losses. The use of automatic control therefore reduces both of the predominant items in the total cost of power; i. e., the energy charge itself and the item of substation wages. Our equipment is adjusted so that approximately three minutes after the demand for power falls below 100 amperes, the station shuts down, this three-minute interval in our case being sufficient to take care of the time consumed by a train in the substation zone, coasting, braking, and stopping. The station delivers current to the line thirty seconds after relay 3 closes, or about thirty-five seconds after the demand for current oc-

curs, there being about a five-seconds delay in the action of the relay 2 to provide against momentary swings bringing the station into action.

Trouble Experienced

This station will be regularly inspected at intervals of about every four or five days, this being done at present by an extra operator who also spends part of his time in line work and affording relief to other station operators. To date the equipment has been remarkably free from trouble, our main difficulty having been from loose contacts at terminals of relays which had not been thoroughly tightened up and were shaken loose by the vibration of the car. These only resulted in shutting the station down, and since going over all these contacts thoroughly there has been no further difficulty.

In addition to this unit the railroad has recently ordered another similar equipment to be installed at another point on the system where present substation spacing is also too great and voltage conditions poor. This additional equipment includes a converter with high reluctance poles which is expected to be practically free from all flash-overs incident to shorts on third rail. Curve drawing meters will be provided so as to give us a record of what is taking place in the station. In addition the relays 23, 24 and 25 will be controlled from d.c. shunts instead of from a.c. current transformers, thus providing an easier means of adjusting the relay settings. Thermal relay protection will be obtained from current transformers on the a.c. side instead of being on the d.c. side as in the present installation.

The company has in operation nine manually operated stations, in four of which the apparatus is located in a building, and in the other five is of a portable nature similar to the automatic equipment. It is planned to provide all of these nine stations with automatic control and probably take advantage of the portable nature of five of them to shift their relative locations so as to provide better regulation over the system.

This unit was completely installed at a cost of approximately $18,500 including the electrical apparatus, the car in which it is installed, the protection fence, concrete platform for power transformers, and spur track on which the car is mounted. This cost does not include the cost of the 60,000/2300-volt transformers and open-air type switching equipment which the power company provided.

The electrical apparatus used in this automatic substation was designed and manufactured by the General Electric Company of Schenectady, New York.

JOURNAL OF ELECTRICITY INDEX

Those desiring copies of the Journal of Electricity Index from January to June, 1920, may obtain them by sending request to the Circulation Manager.

A NEW SCHOOL OF ENGINEERING

BY WALTER HAYNES

The Department of Education of the Portland Y. M. C. A. has established a school which aims to accommodate students who for some reason are unable to take a regular college engineering course. It was found, by paring down the college course of all cultural subjects, that three years were sufficient to cover a technical electrical engineering course. This course admitted men who had had algebra in the high schools. Such high school subjects as trigonometry, physics, chemistry, and English were given as well as subjects strictly along the line of electrical engineering. An abbreviated course in mathematics, with special emphasis upon engineering applications, enabled the students to handle any and all problems which are usually submitted to an engineer. This covers the regular engineering course from algebra to integral calculus, inclusive, except that plane and solid geometry are very much abbreviated. Subdivisions of mathematics, which are included in texts for the sake of completeness, are eliminated.

The laboratory of the electrical engineering school is so completely equipped as to rank well with any first-class electrical engineering laboratory

Considerable attention is given to the writing of engineering reports. The students are required to write a minimum of 150 reports, each one of which, in addition to being a technical paper, is an exercise in English composition. Three years of this instruction seldom fails to teach the student to write a direct, concise, and clear-cut report upon any assigned engineering subject.

There are certain physical and mental limitations inherent in the human make-up. One of these is the inability to retain a high percentage of the subject matter of a given course, when a large number of other dissociated subjects are pursued simultaneously. For this reason, students taking this "abridged" course are probably better trained, and remember a larger portion of the strictly engineering subjects than graduates of engineering colleges. This conclusion is based upon the grades received in competitive civil service examinations with graduates of other colleges, and with their comparative value in engineering work.

SPARKS—Current Facts, Figures and Fancy

(On this page you are told how to eliminate the danger of broken windshields, how to expedite the erection of telephone poles and how to build an attractive house of common earth. Concise and valuable information is also given regarding the largest cheese in the world and the latest in bridal functions as well as bits of data on the electric utilities of California and the electrification of Swiss railroads.—The Editor.)

There are 121 families for every 100 dwellings in this country.

* * *

There are 84 electric utilities in the state of California, operating 75 hydroelectric plants and 50 steam plants.

* * *

Vast deposits of potash are reported as having been discovered in Morocco, valued at two hundred million dollars.

* * *

An inventor has mounted an electric flashlight in the frame of a note book for the use of persons who are obliged to continually work in the dark.

* * *

The latest in bridal functions occurred in a northwestern city recently when a popular bride-to-be was given an elaborate electrical bridal shower.

* * *

Recruits are joining the British army at the rate of 200 per day and many of the men whose period of service was about to expire have re-enlisted.

* * *

In purchasing flour today one finds that the pre-war dollar is worth $0.41, in purchasing sugar that it is worth $0.29, and in purchasing potatoes that it is worth a mere $0.22.

* * *

In parts of China the Standard Oil can is the standard of measurement. The liquid treasure that has gone across the Pacific and Atlantic oceans in Standard Oil vessels exceeds $100,000,000 in value.

* * *

The government of Switzerland has announced an offering of $25,000,000 twenty-year 8 per cent sinking fund gold bonds to provide funds for the electrification of the government railway system of that country.

* * *

The avoirdupois English pound now in use was derived from the weight of 7,000 grains of wheat taken from the middle of the ears and well dried. This was established as the standard pound during the reign of Queen Elizabeth and has continued to the present day.

* * *

All alteration and remodeling work has been stopped on buildings in London because all labor and materials are urgently needed for the construction of new dwellings. It is estimated that an effective house building campaign in London will require at least 45,000 skilled bricklayers. In all England there are now only 50,000 bricklayers as compared with 100,000 before the war.

The biggest cheese in the world was recently brought into being as the result of a day's work on the part of twelve thousand cows. This was sent from California to the National Dairy Show in Chicago. It weighed 357,000 pounds, was eight feet high, and 10½ feet in diameter.

* * *

The first pumping engine made for sale, which dates from 1766 and is preserved near Birmingham, England, was put to a trial under steam recently. The engine was in continuous use for more than half a century. Designed for 13 strokes to the minute, the ancient piece of machinery maintained 16 strokes to the minute at the trial.

* * *

A Silent Guide which is being placed in one of the stations of a London tube labyrinth consists of a map surrounded by numerous plates carrying the names of all stations in the tube. The traveller presses a knob opposite the name of his destination and lights of different colors on the map indicate "where you are," "when to change," and "the place you want."

* * *

The danger of breaking windshields and car windows will be greatly reduced by the use of laminated glass which consists of two sheets of ordinary glass between which is interposed a thin sheet of pyroxylin plastic. These are welded together by hydraulic pressure and the application of the proper degree of heat. The pyroxylin binder prevents any scattering of fragments in the event of violent breakage.

* * *

Architects are suggesting that the high cost of home building in America be reduced by the use of a compressed earth. Clayey and somewhat sandy loam are mixed with straw or hay to prevent cracking. The wall is built in sections by means of a movable frame into which the moist earth is rammed or beaten in four-inch layers. The outer surface of this so-called wall can be color-washed or treated in various ways.

* * *

The tedious process of erecting telephone poles is being greatly expedited through the use of a combination tractor and earth-boring machine which digs the hole and sets the pole in about eight minutes. The boring machine is, in reality, a giant augur which will bore a hole in the ground any size from 2 to 30 inches in diameter, and as deep as 8 feet. When the hole is bored, the steel tower in which the augur is contained is used as a crane to lift the pole and set it in position.

PERSONALS

H. F. Jackson, formerly vice-president and assistant general manager of the Pacific Gas & Electric Company, has resigned his position with that company to become general manager of the Great Western Power Company. Mr. Jackson was formerly president and general manager of the Sierra & San Francisco Power Company, and then when that company's properties were taken over by the Pacific Gas & Electric Company, remained with them until the transfer had been consummated. Mr. Jackson has recently returned from the East where he had been engaged in the sale of some of the bonds of the Sierra and San Francisco Power Company.

Glen E. Arbogast, F. E. Newbery Company, Los Angeles, was a recent visitor in San Francisco.

H. M. Littell of the Southern California Edison Company, Los Angeles, is visiting in San Francisco.

H. L. Hallis, electrical engineer of Chicago, was in San Francisco recently on a combined business and pleasure trip.

P. D. Callahan, representing the Faries Manufacturing Company, Decatur, Illinois, visited Seattle recently on his way east.

Geo. A. Campbell, president of the Reno Gas and Electric Company of Reno, Nevada, visited in San Francisco last week.

H. E. Barre, electrical engineer, Southern California Edison Company, has been away from Los Angeles on a business trip to San Francisco.

F. L. Hutchinson, secretary of the A. I. E. E., stopped in San Francisco last week on his regular tour of inspection of the various sections.

G. A. Girder has taken over the business of Noble D. Powell in Stockton and contemplates extensive changes in the arrangement of the store.

George Boring, district manager, Pacific States Electric Company, Portland, spent several days in Seattle in the early part of July while en route to Spokane.

A. Emory Wishon, assistant general manager of the San Joaquin Light & Power Corporation, was a recent visitor to San Francisco on business for his company.

A. N. Kemp, vice-president of the Southern California Edison Company, is making an extended trip in the East, his itinerary including New York and Chicago.

Earl Wilson, contractor-dealer of Napa, has moved into a new store which is one of the best equipped and most modern stores of its kind in northern California.

H. E. Sanderson, Pacific Coast manager of the Bryant Electric Company, has returned recently from a trip to the northwest cities of Portland, Seattle and Tacoma.

H. H. Courtright, Valley Electric Supply Company, Fresno, recently visited San Francisco to attend a meeting of the committee on the revision of the safety code.

L. S. Ready, assistant chief engineer of the California Railroad Commission, has recently returned from the A. I. E. E. convention at White Sulphur Springs, West Virginia.

I. E. Artz, manager of theindustrial department of the Westinghouse Electric & Manufacturing Company, East Pittsburgh ,has been visiting in San Francisco during the past two weeks.

G. H. Hagar, formerly with the Vallejo Light and Power Company, has been appointed assistant division superintendent with the Great Western Power Company and is now located at Napa.

I. A. Rosok, general superintendent of the Bisbee Improvement Company, has just completed a trip through the West, stopping in the Yellowstone Park, San Francisco and Los Angeles.

H. P. Cramer, who has been motor sales engineer with the General Electric Company at Portland for a number of years, has accepted a position as manager with the Robert Skeen Electric Works.

R. M. Alvord, local manager supply department, General Electric Company, San Francisco, has been in Schenectady on business. He intends to return to San Francisco about the first of August.

R. E. Eltringham, electrical engineer, California Industrial Accident Commission, has spent two weeks in southern California arranging for the formation of a new branch of the commission in that territory.

R. C. Starr, construction engineer of the San Joaquin Light & Power Corporation, who has been in charge of the Kerckhoff project, is to be congratulated on the completion of the tunnel last week which was put through in record time.

L. D. Canfield, assistant service manager at the New York office of the Westinghouse Electric & Manufacturing Company, was appointed district service manager to succeed **L. G. Richards,** who has been transferred to East Pittsburgh.

D. E. Harris, sales manager of the Pacific States Electric Company, recently visited Chicago on a business trip but returned to San Francisco in time to attend the Electric Supply Jobbers' convention at Del Monte on the twenty-ninth of July.

J. E. Woodbridge, electrical engineer with Ford, Bacon and Davis, has returned to San Francisco after a hurried business trip to the East. Mr. Woodbridge returned over the Chicago, Milwaukee and St. Paul Railroad in order to inspect this system.

S. I. Crookes, Jr., electrical engineer from New Zealand, has spent a month recently on the Pacific Coast inspecting the large power developments now under way. Mr. Crookes is connected with the firm of S. I. Crookes and Son, consulting engineers of Auckland, New Zealand.

E. R. Stauffacher, protection engineer, Southern California Edison Company, is attending the Pacific Coast Convention of the A. I. E. E. at Portland and after the convention will go to Montana to inspect the protective system of the Montana Power Company. This system is said to be one of the most complete in the United States.

Stacey Hamilton, statistical engineer for the Portland Railway, Light and Power Company, has recently been appointed organization inspector reporting directly to President Griffith. His new duties will include the making of special inspections, investigations and reports to the president pertaining to the various departments and operating details of the company. Mr. Hamilton has been connected with the Portland Railway, Light and Power Company for some time, and took a very active part in the gathering of the data which made up the Water Power Development Report presented at the recent convention of the National Electric Light Association.

Frederick A. Anderson has recently been promoted to senior electrical engineer, United States Shipping Board, Southern Pacific District. Mr. Anderson has been connected with the electrical industry since 1889 when he was connected with the Sprague Electric Railway, and later designed and installed many industrial plants. In 1901 he accepted a position with the engineering department of the United States Army and was sent to a number of the sea coast forts on the Atlantic Coast in charge of the electrical and mechanical installations. In 1916 he left the services of the government to take up commercial electrical welding but at the outbreak of the war was called into the government services again in the electrical division of the Bureau of Steam Engineering of the Navy Department. Later Mr. Anderson was called to the service of the Shipping Board, being electrical engineer at Hog Island, from where he was transferred to San Francisco as electrical inspector of the Southern Pacific District.

Willard C. Johnson, industrial engineer, Westinghouse Electric & Manufacturing Company, has left San Francisco for Honolulu. Mr. Johnson expects to be away for about three months and while in Honolulu will look after the interests of the Westinghouse Company in that place.

B. J. Holt, of Woodland, whose name is familiar to the readers of the Journal of Electricity on account of his success as an appliance salesman, has gone to San Francisco. Mr. Holt will conduct an appliance selling campaign for the Schwartz Electric Company of San Francisco.

N. J. Sinnott, chairman of the public lands committee of the state of Oregon, accompanied the party made up of the Idaho congressional committee on appropriations and other federal and state officials which visited some of the more notable sites of the Minidoka irrigation project of that state, last week.

Col. E. E. Winslow, United States Army, in charge of rivers and harbors in California, has been inspecting conditions at Lake Tahoe in connection with the application to cut the rim of the lake and use its waters for power purposes. Col. Winslow will hold a hearing at Reno after his investigation and will inspect the power plants which derive their water from the lake.

W. R. Wallace, W. W. Armstrong and **G. F. McGonagle,** Utah state engineers, attended the meeting of the Utah Water Storage Association which took place in Salt Lake City last week. At this time pertinent discussion took place concerning the construction of a reservoir, on the Hailstone site, which will hold about 40,000 acre-feet of water with a dam from 100 to 125 feet high.

A. D. Church, for the past few years district manager for the Midland Counties Light & Power Company, with headquarters in San Luis, has been transferred to the Santa Maria district to take the place of Mr. Ten Eyck, who has returned to college to finish a special course. Charles J. Kelly of the Coalinga district of the company has been transferred to the San Luis district.

Lt.-Col. B. O. Clupek of the Czechoslavak army has been inspecting the various hydroelectric developments in California for the past two weeks. Col. Clupek is here in the interests of the newly formed republic of Czechoslovakia and from San Francisco will go to New York by way of Portland, Seattle, Spokane and Butte, inspecting the water-power developments of the northwest en route.

F. R. Fishback, sales manager of the Electric Controller & Manufacturing Company of Cleveland, Ohio, accompanied by Mrs. Fishback, is making an extended trip through the West. He expresses himself as well pleased with the business outlook reported by his Western representatives.

G. J. Walton, local manager with the California-Oregon Power Company at Klamath Falls, Oregon, has tendered his resignation, effective August 1st. He is one of four men still with the company who were in its service when he entered in 1906. Mr. Walton's place will be filled by **J. C. Thompson** of San Francisco, the present general secretary of the corporation. Mr. Walton will engage in private business.

S. E. Bretherton, Jr., has taken over the business of the Scott Electric Company in Atascadero, California, buying out **W. E. Scott** with whom he was in partnership. Mr. Scott is to locate in the San Joaquin valley and will open up a modern shop in the vicinity of Fresno. Mr. Bretherton recently made a business trip to San Francisco in connection with the new installation of a fire alarm system for the colony of Atascadero.

W. T. Batcheller, electrical engineer with the Seattle Municipal Light and Power System and secretary-treasurer of the Seattle Section A. I. E. E., has just returned from the East where he attended the 36th Annual Convention which was held in White Sulphur Springs, West Virginia, June 29-July 2. Mr. Batcheller recently passed through San Francisco on his way to the Pacific Coast A. I. E. E. convention in Portland.

The picture above was taken during a recent trip over the system of the Southern California Edison Company, and that of the San Joaquin Light and Power Corporation. From left to right are, I. W. Alexander, Manager Bond Sales Department of the San Joaquin Light and Power Corporation, D. H. Braymer, Managing Editor Electrical World, James H. McGraw, President of the McGraw-Hill Company, Inc., and H. R. Stevens, superintendent of construction with the San Joaquin Light and Power Corporation.

OBITUARY

George A. Woolley, district manager of the General Electric Company, Denver, for the past five years and an employe of the General Electric Company for thirty years, has recently died.

E. H. Mulligan, district manager for the Southern California Edison Company at Redlands, died on the afternoon of July 12 following an illness of several months' duration. Mr. Mulligan served as district manager for the Edison Company for twelve years in the Pasadena district and was transferred to Redlands in 1919. In the eighties he was sent to Antwerp, Belgium, as a representative of the Bell telephone interests, introducing American phones in that country. Later he was a conspicuous figure in the pioneering work in electrical generation in California and a member of the "Edison family" from 1908.

It is with deep regret that we record the death, on July 26th, of Mrs. Henry Bostwick, wife of Henry Bostwick of the Pacific Gas & Electric Company. The electrical industry, in which she had so many friends, learns of her death with a real sense of personal loss.

Meeting Notices for Electrical Men

(Plans for the advancement of the cooperative campaign idea in all parts of the West are numerous among the following meeting notices. Accounts of the organization of the A. A. of E. chapters of California, of the Illuminating Engineering Society election and of an Electrical Table at the Portland Chamber of Commerce also appear on these pages.—The Editor.)

Plans of the Northwest for a Cooperative Campaign

The advisory committee of the Northwest Electric Light and Power Association met in Seattle on July the fifteenth and sixteenth. At this time a plan for establishing an electrical cooperative campaign in Washington, Oregon, Utah, Idaho and Montana, was discussed. The matter will be presented at the annual meeting of the Association which is to be held in Spokane, September 8 to 11, and at this time a definite plan similar to that already in operation in California will probably be adopted.

The advisory committee of the Northwest Electric Light and Power Association is made up of fifteen men who represent every branch of the electrical industry.

Members of the committee who represent the central stations are R. W. Clark, chairman, Puget Sound Light & Power Company, Seattle; A. G. McMicken, Portland Railway, Light & Power Company; G. A. Lewis, Washington Water Power Company, Spokane; J. V. Strange, Pacific Power & Light Company, Salt Lake City; J. Ryan Gaul, Montana Power Company, Butte; W. R. Putnam, Idaho Power Company, Boise.

Those representing the jobbers are G. W. Hawley, Intermountain Electric Company, Salt Lake City; J. I. Colwell, Western Electric Company, Seattle; H. L. Bargion, Montana Electric Company, Butte; R. N. Averill, Fobes Supply Company, Portland.

The contractor-dealers belonging to this committee are R. G. McKenny, NePage-McKenny Company, Portland; J. R. Tomlinson, Pierce-Tomlinson Electric Company, Portland; J. F. NePage, NePage-McKenny Company, Seattle; W. M. Meacham, Meacham & Babcock, Seattle.

Result of Advisory Committee Meeting

At a recent meeting the Advisory Committee of the California Electrical Cooperative Campaign decided to undertake educational work on industrial lighting. This work will be built around two exhibits, one to be located in San Francisco, and the other in Los Angeles. These exhibits will be modeled after the industrial lighting exhibit that was shown at the National Electric Light Association convention at Pasadena. Two committees of the Advisory Committee are planning these exhibits at the present time, one committee working in Los Angeles and the other in San Francisco. These exhibits will be in charge of Mr. Spring and Capt. Smith, who will give lectures on industrial lighting in addition to their other duties.

In conjunction with the educational campaign that is being carried on on adequate convenience outlets, the Advisory Committee is having prepared a series of ten stories and illustrations for the newspapers and is taking orders through the field men for the N. E. L. A. booklet, "The Modern Home," as well as for large and small copies of modern electrical home plan number two.

State Organization of the A. A. of E.

The California Chapters of the American Association of Engineers have just completed the formation of a state organization. The name of this organization is The California Assembly of the American Association of Engineers. It consists of one delegate from each Chapter in the state. The officers elected are: T. E. Stanton of Sacramento, president; Burdette E. Moody of Los Angeles, vice-president; Ralph E. Dodge, San Francisco, secretary-treasurer. The other delegates are: I. H. Tielman, Fresno; Arthur H. Adams, Long Beach; George S. Hinckley, Redlands; Thomas H. King, San Diego.

The State Assembly of the American Association of Engineers will handle all A. A. E. matters of state-wide importance or those concerning matters of interest to several Chapters. It will also coordinate the work of the different state Chapters and will cooperate with other technical and civic organizations in advancing matters of mutual interest. California, Oregon and Washington now have A. A. E. state organization. California is the third state of the Union in point of A. A. E. membership.

BUILDERS OF THE WEST — LXXXII

JAMES A. B. SCHERER

In keeping with the magnitude of engineering achievement which has marked the development of the West, the engineering schools and university departments of the Pacific slope rank high among the foremost of American institutions devoted to this field. To James A. B. Scherer, under whose leadership as president the California Institute of Technology has played an important role in formulating and maintaining these high standards of technical education, this issue of the Journal of Electricity is affectionately dedicated.

New Officers of the Illuminating Engineering Society

The officers of the Council of the Illuminating Engineering Society for the fiscal year 1920-1921 have been elected and confirmed by the Council and will assume office on October first. They are as follows: George H. Harries, president; H. F. Wallace, Geo. S. Crampton and J. J. Kirk, vice-presidents; Clarence L. Law, general secretary; L. B. Marks, treasurer; Adolph Hertz, Walton Forstall and Frank S. Price, directors.

Salt Lake City Commercial Club

Former Governor, William Spry, the principal speaker at a recent luncheon of the Salt Lake City Commercial Club, emphasized the necessity of a "back to the soil" movement, and stressed the necessity of educating Congress to understand more clearly the importance of reclamation work, by explaining that the reclamation act of eighteen years ago had only been secured after five years of hard work, and that in those eighteen years only $110,000,000 had been appropriated, of which Utah had received only $3,500,000.

As illustrating the recompense which comes from the proper investment of money in reclamation projects, Mr. Spry said that on the Strawberry project alone the increased product per acre last year had paid the amount expended for water. He also cited how the Twin Falls, Idaho, project had, at its inception, but six families, while it now contained 60,000 persons, adding that in 1918 the Oregon Short Line had hauled away $40,000,000 in products, after all the vast amount necessary for the sustenance of the inhabitants had been deducted.

Mr. Spry briefly outlined the Weber-Provo project, which, he said, contemplated the reclamation of 2,000,000 acres of land, or more than is now under irrigation in the area included in its boundaries. He said this would cost not more than $7,000,000 or $8,000,000. "Our need is to educate Congress to the necessity of reclaiming the public lands, either by irrigation or by drainage," he asserted.

Electrical Table at Portland Chamber of Commerce

The electrical industry of Oregon was well represented at an informal luncheon at the Portland Chamber of Commerce, Friday noon, July 9. Seated around the table were: F. N. Averill, Fobes Supply Company; J. R. Tomlinson, Pierce-Tomlinson Electric Company; W. C. Heston, Portland Railway, Light and Power Company; P. J. Kean, Pacific Power & Light Company; C. M. Will, Fobes Supply Company; J. P. Mundt, secretary Oregon Association of Electrical Contractors and Dealers; F. H. Murphy, C. P. Osborne, Portland Railway, Light and Power Company; R. C. Kenny, NePage-McKenny Company; Geo. L. Meyers, Pacific Power & Light Company, and J. H. Sroufe, Jaggar-Sroufe Company.

The first luncheon held around the Electrical Table which is to be a weekly feature for electrical men at the Portland Chamber of Commerce.

It is planned to have these gatherings every Friday and everyone connected with the industry will be encouraged to get into the habit of taking their Friday lunch at the Electrical Table. No set programs are contemplated, the idea being to secure better acquaintance and closer harmony in the industry.

Contractor-Dealer Meetings in Salt Lake City

A special feature of the regular meeting and luncheon of the Electrical Contractors and Dealers' Association of Salt Lake City, held a short time ago at the Commercial Club of that city, was a very interesting talk by A. T. Tregoning, of the San Francisco office of the McGraw-Hill Company.

Officers of the Electrical Contractors and Dealers' Association of Salt Lake City. Left to right: G. R. Randall, vice-president; L. G. Robbins, treasurer; G. W. Forsberg, president; T. H. Eardley, secretary.

Mr. Tregoning told what was being accomplished in the California Cooperative Campaign, and presented some very valuable ideas and suggestions for a similar movement in Salt Lake City.

At the regular meeting of the Association, held on Tuesday, July 6th, the present officers of the Association were re-elected for another year. The officers are as follows: G. W. Forsberg, president; G. R. Randall, vice-president; L. G. Robbins, treasurer, and E. H. Eardley, secretary.

A. I. E. E. CONVENTION AT PORTLAND

(Continued from page 116)

on the line as induction motors. Many synchronous motors are also used in mine service for haulage.

W. J. Davis pointed out that California companies could not make planned installations without synchronous condensers for voltage control on long lines. Mr. Carpenter of Washington drew attention to the fact that the arithmetic sum of energy and reactive components is a direct gauge of system losses; that is, 99 power factor and 14% reactive give losses of relation of 113 to 100 for unity power factor.

Golf

The results of the golf tournament on Friday, July 23, were as follows:

1st. (Winner of Fisken cup and leather wallet) C. L. Wernicke, low net seventy.

2nd. (Winner of desk clock) E. F. Whitney, low gross seventy-three.

On the completion of the game the players joined the party starting on a trip over the Columbia Highway. The day concluded with a banquet at the Crown Point Chalet, with one hundred and sixty-five present. A feature of the evening was an address by W. H. Galvani of the Right of Way department of the Pacific Power & Light Company.

A large party left on Saturday for Seattle, continuing on number 15 Canadian Pacific Sunday.

The large attendance at this convention and the great enthusiasm shown in both the business and entertainment programs mark it as one long to be remembered by all those present.

REGISTRATION, PACIFIC COAST CONVENTION A. I. E. E.
JULY 21-24, 1920

Apperson, A. L.	Portland, Ore.
Armstrong, G. E.	San Francisco, Cal.
Armstrong, R. M.	Portland, Ore.
Alger, P. E.	Portland, Ore.
Bankus, J.	Portland, Ore.
Barker, G. N.	Portland, Ore.
Barry, E. J.	Tacoma, Wash.
Bastian, H.	Portland, Ore.
Batcheller, W. T.	Seattle, Wash.
Bates, D. I.	Portland, Ore.
Bates, J. H. S.	Olympia, Wash.
Beebe, J. D.	Portland, Ore.
Beeuwkes, R.	Seattle, Wash.
Berui, A. F.	Portland, Ore.
Billica, H. J.	San Francisco, Cal.
Billica, Mrs. H. J.	San Francisco, Cal.
Blackburn, E.	Portland, Ore.
Boring, G. A.	Portland, Ore.
Boring, Mrs. G. A.	Portland, Ore.
Boring, H. A.	Seattle, Wash.
Boyer, W. H.	Portland, Ore.
Boykin, R. M.	Portland, Ore.
Campbell, W. W.	Hoquiam, Wash.
Carlson, E. L.	San Francisco, Cal.
Carpenter, H. V.	Pullman, Wash.
Cayo, A. B.	Portland, Ore.
Childs, R. B.	Seattle, Wash.
Clark, J. C.	Palo Alto, Cal.
Clark, Mrs. J. C.	Palo Alto, Cal.
Code, E. S.	Seattle, Wash.
Coe, C. H.	Tillamook, Ore.
Coldwell, O. B.	Portland, Ore.
Collins, E. S.	Portland, Ore.
Cone, D. I.	San Francisco, Cal.
Corbet, D.	Seattle, Wash.
Crawford, C. C.	Seattle, Wash.
Cunningham, E. . R.	Portland, Ore.

Cushing, A. S. ..... London, England
Dater, D. H. ..... Portland, Ore.
Dashley, L. H. ..... Seattle, Wash.
Davidson, R. J. ..... Portland, Ore.
Davis, W. J., Jr. ..... San Francisco, Cal.
Dearborn, R. H. ..... Corvallis, Ore.
Dederick, C. R. ..... Portland, Ore.
Dodds, J. M. ..... Seattle, Wash.
Easter, R. R. ..... Hillsboro, Ore.
Elder, L. R. ..... Portland, Ore.
Evenson, F. F. ..... Clatskanie, Ore.
Fake, F. C. ..... Portland, Ore.
Fear, Lyle G. ..... Portland, Ore.
Ferrer, F. ..... Portland, Ore.
Frogner, G. A. ..... Spokane, Wash.
Fisken, J. B. ..... Spokane, Wash.
Frost, C. M. ..... Portland, Ore.
Gifford, F. L. ..... Portland, Ore.
Graf, S. H. ..... Corvallis, Ore.
Gray, H. L. ..... Seattle, Wash.
Growden, J. P. ..... Seattle, Wash.
Hampton, J. ..... Portland, Ore.
Harris, G. F. ..... Portland, Ore.
Hartwig, L. ..... Portland, Ore.
Hawley, K. A. ..... New York, N. Y.
Hayward, R. F. ..... Vancouver, B. C.
Healey, E. S. ..... Portland, Ore.
Henny, D. C. ..... Portland, Ore.
Hellenthal, J. ..... Seattle, Wash.
Henderson, D. F. ..... Spokane, Wash.
Henkle, J. C. ..... Portland, Ore.
Heston, W. C. ..... Portland, Ore.
Hillebrand, W. A. ..... San Francisco, Cal.
Hindman, L. E. ..... Portland, Ore.
Hippley, E. ..... Portland, Ore.
Hizawa, G. ..... Tokyo, Japan
Horn, C. H. ..... Oswego, Ore.
Howell, H. D. ..... Denver, Colo.
Husbands, R. H. ..... Seattle, Wash.
Hutchinson, F. L. ..... New York, N. Y.
Hynes, W. F. ..... Portland, Ore.
Hippeley, E. ..... Portland, Ore.
Jones, D. M. ..... Schenectady, N. Y.
Kennedy, J. B. ..... Portland, Ore.
Knowles, C. S. ..... Kennewick, Wash.
Kramer, E. W. ..... Portland, Ore.
Kurtichanof, L. E. ..... Portland, Ore.
Kurtichanof, Mrs. L. E. ..... Portland, Ore.
Lauridsen, L. ..... Portland, Ore.
Lawson, F. I. ..... Minneapolis, Minn.
Ledenbaum, P. ..... Portland, Ore.
Lebanbaum, P. ..... Portland, Ore.
Le Fever, O. L. ..... Portland, Ore.
Lindsay, S. C. ..... Seattle, Wash.
Lindsley, W. R. ..... Portland, Ore.
Lund, C. A. ..... Tacoma, Wash.
Lundell, C. H. ..... Portland, Ore.
Luther, G. D. ..... Seattle, Wash.
Magnusson, Dr. C. E. ..... Seattle, Wash.
Mangold, A. O. ..... Portland, Ore.
Manny, H. H. ..... Seattle, Wash.
Martin, A., Jr. ..... Portland, Ore.
Mastick, R. W. ..... San Francisco, Cal.
Mastick, Mrs. R. W. ..... San Francisco, Cal.
Mears, A. W. ..... Portland, Ore.
Mears, H. J. ..... Portland, Ore.
Meece, J. C. ..... Portland, Ore.
McClung, D. R. ..... Portland, Ore.
McMicken, A. C. ..... Portland, Ore.
McMillan, F. O. ..... Corvallis, Ore.
Merwin, L. T. ..... Portland, Ore.
Miles, J. G. ..... Seattle, Wash.
Miller, A. S. ..... Seattle, Wash.
Miller, C. A. ..... Tacoma, Wash.
Mini, J., Jr. ..... San Francisco, Cal.
Mong, C. E. ..... Seattle, Wash.
Moody, A. S. ..... Portland, Ore.
Moody, Mrs. A. S. ..... Portland, Ore.
Moyer, L. M. ..... Portland, Ore.
Muirhead, J. ..... Vancouver, B. C.
Murphy, M. F. ..... Seattle, Wash.
Monges, R. F. ..... Portland, Ore.
Murphy, F. H. ..... Portland, Ore.
Neill, W. T. ..... Salem, Ore.
Nicholas, R. W. ..... Portland, Ore.
Nims, F. D. ..... Seattle, Wash.
Nixon, G. ..... Spokane, Wash.
Osborne, C. P. ..... Portland, Ore.
Paine, E. A. ..... Portland, Ore.
Pearson, E. F. ..... Portland, Ore.
Peaslee, W. D. ..... Huntington, West Va.
Pestell, W. ..... Chicago, Ill.
Phillips, L. L. ..... Portland, Ore.
Plumb, H. T. ..... Salt Lake City, Utah
Polhemus, J. H. ..... Portland, Ore.
Pratt, A. C. ..... Butte, Mont.
Proebstel, D. W. ..... Portland, Ore.
Prior, D. F. ..... Santa Rosa, Cal.
Quinan, G. E. ..... Seattle, Wash.
Ramsay, J. W. ..... Pullman, Wash.
Rands, H. A. ..... Portland, Ore.
Read, L. ..... Portland, Ore.
Read, J. R. ..... Vancouver, B. C.
Redman, F. W. ..... Portland, Ore.
Reed, M. E. ..... Portland, Ore.
Riggs, A. C. ..... Seattle, Wash.
Robley, R. R. ..... Portland, Ore.
Rockwood, J. A. ..... Portland, Ore.
Rowe, G. H. ..... Boise, Idaho
Ryan, H. J. ..... Palo Alto, Cal.
Ross, L. W. ..... Portland, Ore.
Sampson, C. N. ..... Portland, Ore.
Schoolfield, H. H. ..... Portland, Ore.
Scott, J. D. ..... Portland, Ore.
Scott, W. A. ..... Portland, Ore.
Scott, W. D. ..... Seattle, Wash.
Scott, Mrs. W. D. ..... Seattle, Wash.
Searing, E. D. ..... Portland, Ore.
Shaw, J. L. ..... Portland, Ore.
Shepard, F. H. ..... New York, N. Y.
Shepard, W. M. ..... San Francisco, Cal.
Shinn, J. E. ..... Astoria, Ore.
Siegfried, J. H. ..... Kennewick, Wash.
Skeen, R. ..... Portland, Ore.
Smith, W. C. ..... Palo Alto, Cal.
Sorensen, R. W. ..... Pasadena, Cal.
Stauffacher, E. R. ..... Los Angeles, Cal.
Stafford, R. T. ..... Seattle, Wash.
Streiff, A. ..... Portland, Ore.
Sturges, I. B. ..... Portland, Ore.
Swift, A. H. ..... Powell River, B. C.
Tappan, F. G. ..... Norman, Okla.
Trabert, A. W. ..... Seattle, Wash.
Turner, W. S. ..... Portland, Ore.
Volpe, J. S. ..... Portland, Ore.
Wallis, C. R. ..... Seattle, Wash.
Wakeman, H. R. ..... Portland, Ore.
Walther, H. L. ..... Medford, Ore.
Ward, S. G. ..... Portland, Ore.
Weber, F. D. ..... Portland, Ore.
Wells, J. G. ..... Seattle, Wash.
Wernicke, C. L. ..... Portland, Ore.
Whipple, C. A. ..... Seattle, Wash.
Whitmore, Earl ..... Portland, Ore.
Whitney, E. F. ..... Portland, Ore.
Williams, L. C. ..... Alameda, Cal.
Woodbridge, J. E. ..... San Francisco, Cal.
Wooster, L. F. ..... Corvallis, Ore.
Wright, J. L. ..... Portland, Ore.
Yates, J. E. ..... Portland, Ore.
Zimmerman, P. ..... Yamhill, Ore.

Investment Bankers' Association

At a recent meeting of the Board of Governors of the Investment Bankers' Association of America the following resolution was passed:

"Whereas, Investment bankers are expected to purchase and distribute the securities of public utility companies which must be sold if utilities are adequately to supply the demands upon them for local transportation, light, heat, power and the transmission of messages, and

"Whereas, The credit of many of the public utility companies will not permit the sale and distribution of such securities, thus interfering with the development of many commercial enterprises, the welfare of many communities and the comfort and convenience of a great many people, and

"Whereas, The credit of the public utilities is largely dependent upon the attitude of the public as expressed through the various governing and regulatory bodies,

"It is hereby Resolved, by the Board of Governors of the Investment Bankers' Association of America, that as steps in the restoration of the credit of the public utilities:

"1. Term franchises should be superseded by indeterminate permits securing the right to operate under proper regulation during good behavior with provisions for equitable adjustment of rates from time to time, as tending to eliminate controversies which inevitably impair the public service, the credit of the companies involved and the value of their securities.

"2. The power of regulation and control of public utilities should be vested in state commissions as tending towards standardization of regulation which is not possible under local regulation.

3. Members of state commissions should be appointed.

"If commissioners are elected they are frequently embarrassed by political policies and platforms in the consideration of questions which should be decided only on sound economic and financial principles."

San Francisco Electrical Development League

Because of the numerous vacations which are now under way among men of the electrical industry, the regular weekly meetings of the San Francisco Electrical Development League have been suspended until September.

San Francisco Section, A. I. E. E.

The regular weekly luncheon of the San Francisco Section of the American Institute of Engineers held at the Engineers' Club on July 28th was especially well attended, because of the fact that F. L. Hutchinson, secretary of the Institute, was the guest. Mr. Hutchinson gave a talk on the aims and ideals of the Institute. This visit to San Francisco is a part of the tour he is making in visiting the various A. I. E. E. sections.

COMING CONVENTIONS

American Society of Civil Engineers—
Portland, Oregon, August 10-11

Northwest Electric Light and Power Association—
Spokane, Washington, September 8-11

HAPPENINGS IN THE INDUSTRY

POWER RESTRICTIONS LIFTED IN SOUTHERN CALIFORNIA

H. G. Butler, power administrator of the Railroad Commission of California, has stated that all restrictions on power for companies operating south of Merced will be lifted by the first of September. Mr. Butler stated:

"The restrictions placed on the power companies early this spring, together with cold weather in April, May and June and late rains, increased the available water supply and kept the load light. This, with the new 17,000-hp. power plant of the city of Los Angeles placed in operation a week ago and the three plants which will be in operation within 30 days, one of 8,000 hp. of the city of Los Angeles and two of the San Joaquin Light & Power Corporation, totaling 70,000 hp., have relieved the situation to such an extent that the danger of shortage for this year has passed. It will be necessary, however, to operate all steam plants to practically full capacity during this season. Accidents in the power plants might make restrictions necessary, but they would only be temporary. With normal rainfall this winter there should be sufficient power next year for southern California. In addition to the new plants which have been mentioned, there will be available for next summer, plants now under construction as follows: Southern California Edison Company, 40,000 hp.; Los Angeles Gas & Electric Corporation, 10,000 hp.; San Joaquin Light & Power Corporation, 17,000 hp.; City of Los Angeles Power Bureau, 10,000 hp., and Southern Sierras Power Company, 3400 hp., a total of 80,400 hp."

Mr. Butler also stated that existing restrictions governing the use of power furnished by the companies operating north of Merced had not been removed, but that conditions have recently required that the existing restriction on the companies north of Merced be made more rigid and that there is no prospect of their being removed until the fall rains replenish the streams which supply the hydroelectric plants.

THE FEDERATED AMERICAN ENGINEERING SOCIETIES

One of the outstanding features of the Organizing Conference held in Washington during June was the enthusiastic interest and cooperation exhibited by the delegates of the local, state and regional engineering organizations. It is not surprising therefore that these organizations should be among the first to apply for membership in the Federated Engineering Societies. In this connection it is interesting to note that the Technical Club of Dallas, at its meeting of June 22, made application for membership and at the same time filed its claim to being the first local organization to apply.

The report of the delegates to the Washington Organizing Conference was read at the meeting of the Board of Directors of the American Institute of Electrical Engineers at the annual convention at White Sulphur Springs, West Virginia, June 30, and the following resolution was adopted:

"**Resolved,** That it is the sense of this Board that the A. I. E. E. should join the Federated American Engineering Societies, but that as there is a small attendance at this meeting and a new Board will be constituted commencing with the administrative year on August 1, action be deferred until the August meeting of the Board and that a letter be sent to the members of the incoming Board, with a request that they give careful consideration to the matter and be prepared to act at the next meeting."

The report of the delegates to the Washington Conference was read at the meeting of the Board of Direction of the American Institute of Mining and Metallurgical Engineers on June 25, was favorably discussed and referred to the Finance Committee to devise and report on means of meeting the financial requirements.

The report of the delegates to the Washington Conference representing the American Society of Civil Engineers will be presented at the annual convention of the society, at Portland, Oregon, August 10-12, 1920.

The organization is to deal with what are commonly known as welfare or non-technical matters. It is not a social organization; it is not an organization of individual members. As its title indicates, it is a federation of societies with whose autonomy and activities it in no way interferes. It does not create a new technical society but it will succeed the present Engineering Council and will be more comprehensive as to scope and membership.

WORK ON CARIBOU PLANT

Work is being rushed on the tunnel to connect Big Meadows with Butt Valley, where the Great Western Power Company is constructing its $8,000,000 Caribou hydroelectric plant. Some of the canals and ditches at the upper end of the transmission system have been completed. Most of the remaining work remains at the Caribou end of the project.

CALIFORNIA-OREGON POWER COMPANY APPLIES FOR RATE READJUSTMENT

The California-Oregon Power Company has asked for final readjustment of its rate on the grounds that it is now in a position to determine the effect upon its revenue of the rates fixed by the Railroad Commission on a previous application. In its former decision the Commission ordered the company to withdraw meters with the result that today more than 90 per cent of its consumers are being so served, a fact set up by the company in its request for the final readjustment of rates. It is further claimed by the company that it has in prospect the organization of its financial structure with a view to enabling it more readily to obtain the necessary funds for the construction of new power plants or increasing the capacity of existing plants and making extensions and enlargements of its system for the logical and proper development of its territory.

ENTERPRISE ELECTRIC COMPANY PLANS NEW PLANT

The Enterprise Electric Company, operating in the northeastern part of the state of Oregon, which supplies power and light to the towns of Enterprise, Evans, Joseph, Lostine, and Wallowa, will begin construction at once of a hydro-electric plant diverting the waters of the Wallowa river above the lake. The first unit to be installed will consist of a Henry impulse turbine operating under a head of 800 feet, which will drive an 800-kilowatt, 6600-volt, 60-cycle, 3-phase generator. The company at present has a generating capacity of 400 hp. and has three plants at Joseph, Enterprise and Wallowa.

The above picture was taken at the annual meeting of the California Association of Electrical Contractors and Dealers which was held in San Jose a short time ago. A full report of this convention appeared in the last issue of the Journal of Electricity.

EDISON MEN VISIT KERN RIVER

Over seventy of the district managers and department heads of Southern California Edison Company composed a party which visited the new plant, Kern River Number Three, during the last week in June. The object of the excursion was to explain the details of the project to the commercial men whose duties as a rule prevent their acquiring an intimate knowledge of the company's work in the mountains. The party was taken over the entire project, the excursion concluding with a business meeting and entertainment program at the construction camp.

PACIFIC GAS & ELECTRIC COMPANY TO BUILD HIGH HEAD PLANT

The Pacific Gas & Electric Company is preparing plans for a power house to be located on the Stanislaus river on property acquired by lease from the Sierra & San Francisco Power Company. This power house will have a head of 2400 ft. which will make it one of the highest head plants in the United States. The plant will have a capacity of 7500 kw. and work will be started on it at once so that it will be completed by this winter. Some other work is being done on the property of the Sierra & San Francisco Power Company, part of this being a third penstock which is being installed on the Stanislaus plant to increase its efficiency.

CALIFORNIA STATE WATER COMMISSION MAKES HYDRO-GRAPHIC SURVEY

The engineering department of the State Water Commission has commenced a hydro-graphic survey of Hat Creek in eastern Shasta county. Mr. Gordon Vander, engineer for the Commission, is in charge of the work, and measurements are being made of the capacities of all irrigation ditches and the quantity of water diverted from the stream by the various water users. This survey is being made in connection with the case of Doyel vs. Massie, et al., which involves seventy-three claimants of water rights from the creek. The case originally involved as plaintiff and defendant only a small proportion of the water users on Hat Creek, but in order to determine all water rights on the stream at once and so forestall future litigation, all the water users on the stream were brought into the case, which has been referred to the Water Commission to make findings.

ANNUAL STOCKHOLDERS' MEETING

At the annual meeting of the stockholders of the Idaho Power Company, held in May, the following directors were elected:

George A. Bremer, J. W. Cunningham, E. H. Dewey, R. B. King, C. E. Groesbeck, F. F. Johnson, W. P. Lyon, O. G. F. Markhus, D. F. McGee, E. J. Ostrander, W. R. Putnam, D. W. Standrod, E. R. Tinker, E. A. Van Sicklin, William T. Wallace, H. J. Ward.

At the first meeting of the board since the annual stockholders' meeting, the officers of the company were elected for the ensuing year:

President, F. F. Johnson; chairman board of directors, F. F. Johnson; vice-president, William T. Wallace; vice-president and general manager, W. R. Putnam; vice-president, E. W. Hill; vice-president, D. F. McGee; general superintendent, R. B. King; chief engineer, W. H. Trenner; secretary, C. T. Ward; treasurer, A. E. Janssen; assistant secretary, E. P. summerson; assistant secretary, H. L. Martin; assistant secretary, A. E. Janssen; assistant treasurer, William Reiser; assistant treasurer, A. C. Ray; assistant treasurer, R. W. Miller; assistant treasurer, G. J. Hickman; clerk, Ernest L. McLean.

EXTENSIVE LIGHTING SYSTEM FOR LONG BEACH

At an informal conference of the City Commissioners of Long Beach plans were discussed for making a uniform system of ornamental street lighting throughout the business district of the city. Under a proposed ordinance electroliers will shortly be erected on Fourth Street between Pine and Alamitos streets, the plans calling for a steel standard costing approximately $100.00. At the present time there are several different styles of standards in service in Long Beach and it is the desire of the commissioners and city engineers at this time to take steps towards having a uniform system. City Attorney Hoodenpyl favors the cement standard on the ground that metal posts rust in the moist air of the beach.

STEAM HEATING RATES

The Northwestern Electric Co. of Portland, through an application filed with the Oregon Commission July 2, asks for an increase in steam heating rates. The hearing will probably be set for some time in August. The company states in its application that the revenue from its steam heating department is not sufficient to cover the cost of operation.

ELECTRIC POWER CONSUMPTION, C. M. & ST. P. RAILWAY

(Continued from page 118)

Costs of Maintenance and Operation

The cost of maintaining and operating the transmission lines, substations, and trolley system, for the year 1919 is given below and a final figure thus arrived at showing the approximate total operating costs involved in the delivery of the electric energy to the locomotives.

	Account	Total All Services	Per Unit
255.	Power Substation Buildings	$ 8,487	$ 606.00 per Bldg.
257.	Power Transmission System	1,773	4.87 " mi.
259.	Power Distribution System	78,461	179.00 " route mi.
261.	Power Line Poles and Fixtures	24,299	55.50 " " "
306.	Power Substation Apparatus	40,224	2870.00 " station
383.			7300.00 " "
395.	Train and Yard Power Produced	102,152	
	Total,	$255,396	

The installation being comparatively new it might naturally be assumed without consideration of other facts that the figures for the maintenance are considerably lower than those which will eventually obtain, but it should also be borne in mind that the maintenance and operating costs given will, except for power, remain more or less constant as far as any consideration of their being affected by the business handled is concerned, so that the cost per thousand ton miles would be correspondingly reduced as business is increased. It is also expected that considerable improvement will be effected in maintenance methods which would again tend to reduce costs. The figures are therefore given merely to show the results which are at present being obtained.

SEMI-ANNUAL SALES CONFERENCE

The San Francisco district of the Western Electric Company held its semi-annual sales conference July 15 and 16. The meeting proved to be one of the most interesting and successful events of the year in the electrical industry on the Pacific Coast.

An interesting feature of this Conference was an invitation extended by the Western Electric Company to its contractor and supply-dealer customers to attend the meetings and listen to the sales talks by manufacturers. That this invitation was appreciated is evidenced by the large attendance and keen interest shown.

The banquet and entertainment Friday evening, over which W. S. Berry, district manager of the Western Electric Company, presided, proved a fitting climax to the business sessions.

AUTHORITY TO ISSUE NOTES

The San Joaquin Light & Power Corporation has been authorized by the Railroad Commission to issue notes in the aggregate face value of $388,163.31 to pay or refund notes now outstanding. The original notes were issued in connection with the financing of construction work on the company's plant at Bakersfield and for hydroelectric development.

The Commission has also authorized the San Joaquin company to endorse notes to be issued by the Midland Counties Public Service Corporation, the payment of which will be secured by the deposit of $605,000 of bonds, authority to issue which has been granted by the Commission.

Western States Gas and Electric Company has been authorized by the Railroad Commission to issue $300,000 face value of its 6½% collateral trust notes, due August 1, 1923, and to issue and deposit as security for the payment of these and other notes issued under authority of the Commission $439,000 of bonds, also authorized by the Commission. A supplemental order by the Commission provides for the disposition of the proceeds of the sale of $198,000 of bonds.

THE ELECTRIC FURNACE LOAD

A letter to the Editor

The Journal of April 15th, page 358, reviews an article by Mr. W. M. Shepherd, who gives some very good information as to the extent and possibility of the electric load for Californian central stations. We are very glad to see the assurance given by such an authority as Mr. Shepherd that the electric furnace load is desirable, and one that does not need particular nursing by the central stations. There are still very substantial shipments of steel castings from the East, but in our opinion it is only a matter of time before the castings manufacturers in the West realize that a properly constructed and designed electric furnace will give them equally high quality of castings to those made in the East.

In connection with this, we would suggest that the intending furnace user should not place too much prominence upon the remarks of Mr. Shepherd as to the use of an acid lined furnace rather than a basic lined. For melting up scrap of good quality rapidly, there is no doubt that the acid furnace has much to commend it, but the steel maker should not lose sight of the fact that the electric furnace is primarily a refining and purifying instrument. It is not the cheapest melting down instrument. Refining is impossible in the acid lined furnace, and thus one of the chief advantages of the electric furnace is lost by an acid lined furnace.

It is not the purpose of this letter to advocate basic lined furnaces, but merely to point out that a basic furnace will run just as fast as an acid furnace—it is merely a question of the number of heat units put into the furnace—and in addition the basic furnace user is bound to refine his charges, even if he does not go to the length of changing slags, as when making high grade steels.

Many of the better steel makers out in California are running their furnaces basic, and if the steel casting maker in California wishes to compete in quality as well as quantity with the Eastern manufacturer the basic lined furnace will be found generally to be more satisfactory.

The acid lined furnace is often the refuge of the man who wishes to convert 100% scrap into 50% castings and get 100% prices. Unquestionably, the better steel can be made in basic lined furnaces, and it is along this line that real development of California's steel casting making will come.

Yours very truly,

FRANK HODSON, President,
Electric Furnace Construction Co.

ELECTRIC WELDING OF COPPER

A letter to the Editor.

(A letter of inquiry recently reached this office regarding a copper welded ring referred to in an article by F. A. Anderson in the Journal of Electricity, December 1, 1919, and January 1, 1920. As the author's reply may be of interest to others, a part of it is reproduced here.—The Editor.)

The Journal of Electricity:

This ring was not welded by the Slavianoff process, but was an arc welding operation.

By referring to the article mentioned you will see that the Slavianoff process uses the welding rod as an electrode, and that the Bernardos process uses one carbon as an electrode, while the welding rod of the desired metal is fed into the arc. There have arisen so many variations that these names are rarely used today and the term "arc welding" includes all of the original processes together with the numerous variations which have been developed to meet conditions.

Again referring to the ring, this is one of several which were cut from an edgewise wound copper coil, the ring was then placed on a graphite plate; at the open ends a small piece of the same copper is laid, then by the use of a half inch carbon electrode a short arc was struck on the extra piece of copper. As soon as fusion was started the carbon electrode was placed against the metal, closing the arc and using the heat generated by the contact resistance to hold the metal in a molten or fluid state until a uniform thickness and union of the metals had been obtained. While the metal was still red hot, it was immersed in water. It was then reheated and cooled two or three times, this process changing the character of the metal in the weld from that similar to a cast state into that more nearly resembling the wrought state. After this the ring was finished by filing and using fine emery, since which time it has been almost impossible to detect the place where the weld was made.

The machine used was a variable voltage arc welding set in which it was possible to get a very low voltage and to adjust the amperes to the desired value.

Such an arrangement as is used in welding this copper may not be possible in general practice, but it is almost always possible to find a way of accomplishing the desired result. It would, however, be hard to give advice that would apply generally, for the conditions existing would have to be studied and a plan devised for meeting them.

It has been common practice for a number of years to weld copper by the resistance method and where it is convenient to apply this method its application becomes simpler and more satisfactory.

FILING PAMPHLETS

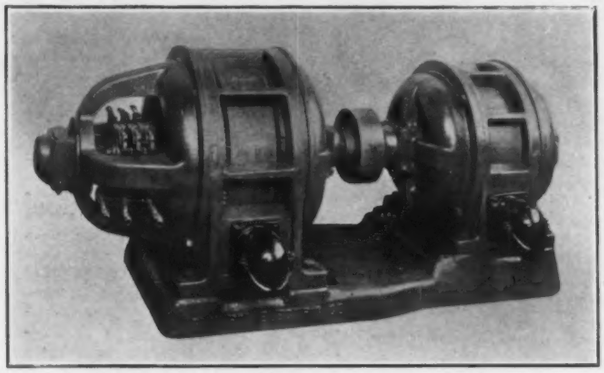
The filing of pamphlets and clippings is inadequately done in most business libraries. A series of articles by Miss Virginia Fairfax, librarian with the Carnation Milk Products Company, which is to be started soon in the Journal of Electricity, will take up this subject in detail. Watch for it.

LATEST IN EVERYTHING ELECTRICAL

(The device shown on this page is of particular interest because it makes it possible to apply high speed induction motors to various types of machines, thus eliminating belts or gears. An ingenious arrangement of a double-duty socket is also shown. Among the Books and Bulletins appear brief reviews of an Electrical Trades Directory from England and of technical university publications.—The Editor.)

NEW APPLICATION OF HIGH SPEED INDUCTION MOTOR

A new application of the high speed induction motor to certain classes of machine drive, especially in the wood working and metal trades industries, has been made possible by the development of an induction frequency changer by the General Electric Company. This device generates power at frequencies which will produce speeds of 18,000 r.p.m. or higher, and, as a result high speed induction motors can be directly applied to various types of machines, eliminating belts, or gears with their disadvantages.



Induction frequency changer IH 332-60/270-25 kw.-1800 B-220/155 direct connected to induction motor KT-323-4-30-1800 B-220.

The frequency changer is a simple enough device, consisting of a slip ring, or wound rotor type of induction motor, which may be driven either by a belt, or directly, the stator being connected electrically to an a.c. source of power. By rotating the machine in a direction opposite to that in which it would run as a motor, frequencies are generated in the rotor equal to that of the exciting circuit plus that due to the reversed rotation of the rotor.

Practically all the energy taken from the commercial circuit is transformed into high frequency energy to drive the machine motors, the overall efficiency being approximately 90%. Where d.c. power is all that is available an inverted rotary converter can be used both as a motor to drive the frequency changer and supply the excitation for the stator. The high frequency supplied by this device being always three-phase secures uniformity as well as economy and simplifies both the motors and the frequency changers. The most economical sets are those having driving motors direct connected to the frequency changers.

Successful applications of these motors have been made to such wood working machines as shapers, saws, tenoners, and drills, all applications being direct with speeds ranging from 7200 r.p.m. to 12,000 r.p.m.

DOUBLE-DUTY SOCKET DISPLAY

The demand for a two-outlet socket has increased so that the Bryant Electric Company of Bridgeport, Connecticut, have decided to handle the production and packing of same as a separate, complete article rather than as a part of their "New Wrinkle" line.

Each socket is now being packed in a three-color carton, which not only facilitates handling but serves to enhance shelf and counter display. In addition an unique counter or window display box is provided for the use of dealers. This is printed in three colors to harmonize with the individual containers. One of these display boxes, with two dummy containers and a special cradle, is included with each standard package of twenty sockets. An effective display can readily be arranged with this outfit—using an actual socket resting in this special cradle between two individual containers as shown in the illustration.

The effective display which can be arranged by placing a double duty socket between the two individual containers.

BOOKS AND BULLETINS

Electrical Trades Directory

The Electrical Trades Directory and Handbook or Blue Book, as it is popularly known, is the recognized work of reference for the electrical engineering and allied trades in England. Benn Brothers, Ltd., publishers of this directory, announce that the 1920 edition marks its 38th consecutive issue and that this year it has been re-set from cover to cover.

The handbook section deals with power distribution and transmission, with traction, submarine cables and land lines of the world and with wireless telegraphy and telephony. The legal digest has been compiled by a well-known authority on the law as it relates to electricity supply. The alphabetical section contains the name and address of practically everyone associated with British electrical engineering and allied industries, of municipal authorities and supply companies, with important details of the supply systems and the names of chief officials.

University Publications

The Engineering Experiment Station of the University of Washington has published a bulletin under the title, "Electrometallurgical and Electrochemical Industry in the State of Washington," by Charles Denham Grier.

This paper makes a general survey of the requirements of electro-metallurgical industries in the state of Washington, in such a way as to give the non-technical reader a better understanding of the matter. The chapters on Potential Water Power are especially interesting.

NEW ELECTRICAL DEVELOPMENT

(The Northwest reports plans for the extension of power lines and for the construction of a hydroelectric plant on the Wallowa River. Items of interest from the Pacific Central District include the rebuilding of a high-voltage line, plans for the construction of electrically-driven vessels and the announcement that power shortage has been removed. Extensive improvements on electric railway lines are being planned in the Southwest while the Intermountain District reports important meetings, progress in street lighting and plans for the construction of a new power plant.—The Editor.)

THE PACIFIC NORTHWEST

HELENA, MONT.—The Commercial Club is taking up with the city authorities the question of establishing a lighting and parking district the full length of Helena Avenue.

YAKIMA, WASH.—Pacific Power & Light Company, in this place, has plans under way for construction of a $10,000 boiler house, which is desired to provide room for another gas bench.

BEND, ORE.—Charles A. Brown, president of the Bend Water, Light & Power Company, announces that power development of Tumalo Creek will be definitely started this summer. The cost of two plants contemplated is $250,000.

NANAIMO, B. C.—Laying a mile pipe line from a 200-acre reservoir in the mountain district to Milstone is an extension to its system that is to be constructed by the Nanaimo Electric Light Company. The new power house will be constructed at the end of the line.

BELLINGHAM, WASH.—Application has been made by the Puget Sound Power & Light Company for a fifty-year franchise to extend power lines over a total of 30 roads in Whatcom county and to many parts of the county not now supplied with light and power. A hearing will be had on August 9.

PORTLAND, ORE.—The American Can Company has made application for a building permit to construct a three-story factory in the Guilds Lake district, to cost when completed between $1,000,000 and $1,500,000. The plant will be electrically operated throughout and will have an installed motor capacity of about 500 hp., consisting principally of 220-volt induction motors.

SPOKANE, WASH.—The Nixon-Kimmel Electrical Company of Spokane has put out a special unit consisting of dynamo, meter, switchboard and all necessary equipment for a farm lighting system, which is reported to be meeting with good demand. According to Mr. Nixon, the advantage of the unit is that it admits of the engine being used not only for generating lighting current but for other purposes at the same time.

TACOMA, WASH.—The State Public Service Commission has handed down a decision that the local street car company may for six months charge a ten-cent fare. The decision provides for the sale of commutation tickets at 8 cents each. The higher rate will be put into effect at once. The company has been charging a seven-cent fare. The commission specifies that when the company is relieved of certain franchise obligations commutation tickets shall be sold for 6 2-3 cents each.

PORTLAND, ORE.—The Enterprise Electric Company, operating in the northeastern part of the state of Oregon, will begin construction immediately of a hydroelectric plant diverting the waters of the Wallowa River above the lake. The first unit to be installed will consist of a Henry impulse turbine operating under a head of about 800 feet, which will drive an 800-kw., 514-r.p.m., 6600-volt, 60-cycle, 3-phase generator. The company at present has a generating capacity of 400 hp. in its three plants at Joseph, Enterprise and Wallowa.

SEATTLE, WASH.—NePage-McKenny Company, electrical engineers, contractors and manufacturers, Armour building, Seattle, have secured the contract for installation of complete electrical equipment in the proposed two-story and basement office building to be erected for the Poulson Logging Company at Hoquiam, Washington, by J. L. Putnam, Securities Building, Seattle. Bebb & Gould, Securities Building, Seattle, are the architects on this job. The company also has the contract for installation of complete electrical equipment in the armory building to be erected in Everett, Washington.

THE PACIFIC CENTRAL DISTRICT

SANTA CRUZ, CAL.—The water system will be improved, $15,000 having been set aside for the extension of pipe lines and other work.

MILL VALLEY, CAL.—An election will be held July 31st to vote on the formation of a lighting district to be known as Tamalpais Valley Public Highway Lighting District.

CORNING, CAL.—Fire started by lightning destroyed the Pacific Gas & Electric Company's substation here and as a result the town was without light and water for 24 hours. The damage was placed at about $10,000.

SAN FRANCISCO, CAL.—A recent order by the Railroad Commission authorizes the Southern California Edison Company to subject to its mortgages the property and franchises recently acquired by the purchase of the Mt. Whitney Power and Electric Company system.

HILO, T. H.—The Hilo Electric Light Company, by reason of steady decline in its water supply, has been compelled to resort to a reserve steam engine to provide light and power. It is the opinion of some citizens that the supervisors should be induced to erect a pumping station.

SAN FRANCISCO, CAL.—The Sacramento Short Line is building a new substation at Concord, for the accommodation of the new fast electric car service now being scheduled. Hydroelectric power will be supplied by the Western Power Company. Assistant Supt. Neill is directing the new installation.

GREENVILLE, CAL.—Work on the tunnel leading from Lake Almanor to the new Caribou power plant in Butte Valley of the Great Western Power Company is progressing rapidly. The men have been paid large bonuses to rush the work. Some of the contracts on the upper end of the project are complete. Superintendent E. W. Beardsley and Consulting Engineer J. M. Howells are looking over the work.

YUBA CITY, CAL.—A meeting of all power users in Sutter county was called here on July 28th by Farm Adviser C. E. Sullivan at the instance of the State Power Commission. Officials of the Pacific Gas & Electric Company were present to explain to power users why restrictions have been placed this season, the restrictions seriously hampering many growers as well as crippling dredging, mining and other industries which require large voltages.

SACRAMENTO, CAL.—Late rains and low temperatures have removed the danger of a 20 per cent power shortage this summer, which had been threatened earlier in the season, State Power Administrator H. G. Butler said in an adddress here at a banquet to the Pacific Coast Rice Growers' Association. The shortage will not be serious except in case of accident, he said, provided the rice growers and other users continued to conserve electric energy.

SAN FRANCISCO, CAL.—The $10,000,000 Pacific Gas & Electric Company five-year 7 per cent convertible gold notes, recently underwritten by Blythe, Witter & Co. and associates, have been entirely sold out and the syndicate is closed.

PLEASANTON, CAL.—Carl A. Reitz, inventor of small electrical motors, is here looking for a factory site. He states that he has an order from a barber supply concern in San Francisco for $36,000 worth of motors to be attached to hair clippers.

NEVADA CITY, CAL.—The high voltage line of the Pacific Gas & Electric Company between the Colgate and Drum power houses is to be rebuilt during the next few months in order that the carrying capacity may be increased from 30,000 to 60,000 voltage. Materials are now being assembled and crews organized for the work. The line is thirty miles in length, and the rebuilding is estimated to cost $225,000. The work will not be completed before January 2.

SAN FRANCISCO, CAL.—The Middle Yuba Hydro-Electric Power Company, which sells electric energy in the vicinity of Allegheny and Forest, Sierra county, has applied to the Railroad Commission for authority to increase its rates 15 per cent. The company buys its power from the Pacific Gas & Electric Company which was recently granted a raise of 15 per cent and it is to meet this additional cost of power that the Yuba company would advance its charges.

SAN FRANCISCO, CAL.—A. F. Haines, vice-president and general manager of the Pacific Steamship Company, has announced that plans for the construction of two electrically-driven vessels with a speed of twenty-three knots have been submitted for bids to Eastern and Pacific Coast shipbuilders. They will cost in the neighborhood of $4,000,000 each and will have a carrying capacity of 590 passengers each. They will be placed in the Pacific Coast service between San Francisco, Los Angeles, San Diego, Seattle and Victoria.

SAN FRANCISCO, CAL.—Application for authority to increase its rates for electricity and gas sold in its Stockton division has been filed with the Railroad Commission by the Western States Gas & Electric Company. The Western company, which buys considerable energy from the Pacific Gas & Electric Company and the Great Western Power Company, claims that recent surcharges granted these companies by the Commission will add $48,000 a year to its bills for purchased power, and that wage increases will add about $36,000 a year to its pay roll.

SAN FRANCISCO, CAL.—Because the net income of the Ojai Power Company, which purchases its electric energy from the Southern California Edison Company, was practically wiped out by the increase in rates recently allowed the Edison Company by the Railroad Commission the Commission has granted the Ojai company authority to add a surcharge of 20 per cent to its power bills. The rate for lighting now being collected by the Ojai company is not disturbed by this ruling. The Ojai company operates in the Ojai Valley, Ventura county. The major portion of its business is supplying electricity for pumping purposes. The surcharge is to continue for twelve months, having been made temporary because the surcharge allowed the Edison company is of an emergency nature.

THE PACIFIC SOUTHWEST

LOS ANGELES, CAL.—The Baker Electric Company has leased the ground floor and basement of the two-story brick building, 445-453 S. Los Angeles Street.

TOMBSTONE, ARIZ.—Notice has been given that a special election will be held August 10th in the irrigation district now being formed and designated as San Pedro Water Users' Association, to determine whether the proposed district shall be organized.

ONTARIO, CAL.—Officials of the Pacific Electric Railroad announce that it is planned to extend the road from Corona-Riverside line to the Los Angeles-Sterns line, by building a road through Santa Ana canyon. This would give a direct line into Riverside via La Habra and Corona.

MEXICALI, MEX.—Thirty-one bids were received in Mexicali for a municipal water system to cost $500,000. Thirty represented American concerns located in many parts of the United States. Because of the many bids of varied nature it will be several days before the contract is awarded.

LONG BEACH, CAL.—Practically all work on the city's new water well number 1 has been finished and as soon as the cement work is sufficiently dry water will be started through. Work on number 2 well will start immediately, to be completed within 30 days. More wells will be sunk as necessity demands.

TUCSON, ARIZ.—At a special meeting of the city council a permanent solution of the problem of purifying the water supply was offered when Councilman Mansfield proposed purchase of a chlorinating plant for use in connection with the pumping plant. The purchase of this plant met with favor by the mayor and other councilmen.

LOS ANGELES, CAL.—Extensive improvements involving the expenditure of $150,000 have been announced by the Los Angeles Railway Company. The Western Avenue line will be extended from the present terminus to Santa Monica Boulevard. This improvement will cost $50,000 and will be started as soon as necessary equipment is delivered. A new substation equipment will be installed to facilitate the receiving of power.

SANTA FE, N. MEX.—Sealed bids are being received by the board of trustees of the village of Deming, Luna county, New Mexico, up to 6 o'clock p.m. Aug. 2, 1920, for the sale of bonds of said village in the amount of $100,000 for the purchase of the construction of a system for supplying water to the village. Said bonds will bear date of August 1, 1920 and will be issued in denominations of $100, bearing 6 per cent interest payable semi-annually. Bids must be accompanied by a certified check of $2,500.

LOS ANGELES, CAL.—A conference has been held at Hotel Lankershim with Arthur P. Davis, Director of the United States Reclamation Service, for the discussion of the prospective gigantic engineering feat of harvesting the melting season floods of the Colorado River for irrigation of millions of acres adjacent to the desert and dry land, with the chief reservoir on the Boulder Canyon site near the junction of the boundaries of Arizona, Nevada and California, Imperial Valley being one of the chief beneficiaries. The reservoir will cost more than $50,000,000.

THE INTER-MOUNTAIN DISTRICT

BURLEY, IDA.—A special train arrived here last week bringing the members of the congressional committee on appropriations and other federal and state officials to visit some of the more notable sights of the Minidoka project.

BOISE, IDAHO.—The reclamation service will open bids at Boise August 24th for building sixteen miles of main canal on the Boise project. The work involves the excavation of 1,229,000 yards of material, and will be done near Caldwell, Idaho.

SALT LAKE CITY, UTAH.—Applications for more than 1,000,000 horsepower have been filed with the water power commission since the new water power bill became effective, according to Ralph R. Woolley, engineer of the United States Geological Survey.

BRIGHAM CITY, UTAH.—At a recent meeting of the city council, plans were discussed and details got under way for the calling of a special election to vote on the issuing of bonds in the approximate sum of $120,000 for the rebuilding of the municipal electric light plant.

PARK CITY, UTAH.—The mines in the Alta and Cottonwood districts, practically all of which use electric power in their operations, are showing considerable activity recently, and several of them are resuming operations after being closed down, as far as shipments are concerned, for several months.

RIGBY, IDA.—The Rigby Electric Supply Co. of this city, and the Rexburg Electric Supply Co. of Rexburg, have consolidated their businesses and have opened their new place of business in Idaho Falls under the name of the Farm and City Electric Company. This makes one of the best equipped electric supply houses in Idaho Falls.

MT. PLEASANT, UTAH.—An increase in lighting rates has been proposed by the mayor and city council. The proposed increase is as follows: From 7c. to 9c. per kw-hr. for lights; from 2c. to 3c. for domestic power; from 2c. to 5c. for commercial power. The above increase is subject to approval by the public utilities commission of Utah.

McCAMMON, IDA.—For the purpose of installing brighter street lights as several street intersections, the Utah Power & Light Company, at the request of the city council of this city, is testing out a number of 1000-candlepower lights, which will probably be accepted by the city, and placed in service within a short time. This will result in much-needed improvement.

ST. GEORGE, UTAH.—Sixteen pumps, with a total of 315 horsepower, are now being driven by electricity furnished by the Dixie Power Company in Parowan valley without lowering the level of the underground water. The community of Enterprise and vicinity will soon have a number of wells driven by electricity. It is believed the water strata in that locality is practically inexhaustible, and if such proves to be the case great development, including large sugar beet acreage, to keep the large sugar factories going, will undoubtedly take place.

SALT LAKE CITY, UTAH.—One of the most successful conferences of division managers and department heads was held by the Utah Power & Light Company at its general offices in Salt Lake City on July 15 and 16. D. F. McGee, of the Electric Bond & Share Company, and Lafayette Hanchett, who was recently elected president of the Utah Power & Light Company, attended the conferences. Some very interesting and instructive discussions took place. These conferences of division managers and department heads are held every two or three months, and the discussions and exchange of ideas are of considerable value to all concerned.

BOISE, IDA.—In the case of the Utah Power & Light Company the public utilities commission of Idaho has decided that regulations now in force must stand until more complete information concerning the valuation of the company's property is at the disposal of the commission. A complete survey of the company's property is necessary in determining just and reasonable rules for the extension of their service in the state of Utah, and such survey for the purpose of obtaining a valuation is now in progress. The power company's extension rule is the particular regulation which has been under consideration.

BONNERS FERRY, IDA.—C. D. Aspinwall, representative of the Westinghouse Electric & Manufacturing Company, was in the city recently looking over the power site on the Moyie. He has since sent in a detailed estimate of the cost of machinery, wire and equipment necessary to install the plant and running power line to the city limits. His estimate for a generator and 500-hp. Pelton-Francis water turbine for 75-ft. static head and 70-ft. effective head with 200 feet of steel pipe for penstock, wire for transmission line and all material necessary for the plant except poles and building is $36,000 f.o.b. Bonners Ferry. It is estimated that the cost of poles, labor, buildings, etc., will cost $20,000.

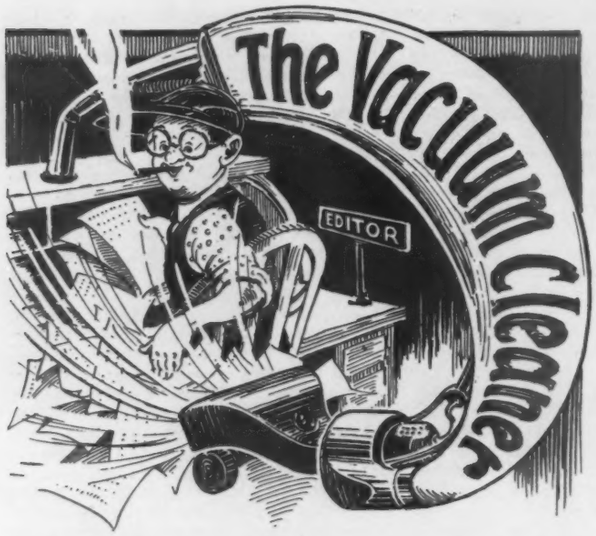
OGDEN, UTAH.—Through the installation of electrical pumping equipment, it is believed that Ogden's water supply can be greatly increased by pumping at the city wells in Ogden canyon, and through thus accelerating the flow the city need not look for other sources for years. It is believed that beneath these artesian wells there is a huge reservoir of water, and an almost unlimited supply can be obtained through forcing the water to the surface with compressed air, and the cost would be comparatively low. Before it is decided to purchase permanent pumping equipment, tests will be made by the city in August with an air compressor and electric motor tendered by the officials of the Amalgamated Sugar Company. This equipment will be loaned to the city without charge, and the tests will cost practically nothing.

SALT LAKE CITY, UTAH.—Answer has been filed with the state public utilities commission by the Telluride Power Company to the complaint made by the town of Milford that it has been overcharged for electric current. The power company sets out that in the past the electric service for the municipal pumping plant at Milford has been supplied under a special flat rate which is not included in any of the published power schedules of the Telluride company. Last December the company notified the town clerk that beginning with January the power would be charged for under schedules 7 and 8, which have received the approval of the public utilities commission, and that the town has been billed accordingly. The company claims that the charges are legitimate, and must be made in order that the service may not be supplied at a loss.

SALT LAKE CITY, UTAH.—A meeting of the Utah Water Users' Storage Association was held in this city on July 27th. At this time A. F. Parker, chief engineer of the association, set forth suggestions with regard to the utilization to the highest degree of efficiency of the waters of Provo and Weber rivers systems in the irrigation of lands in the eight counties clustering around Salt Lake City, Ogden and Provo. The executive board of the association has voted to ask the eight counties in the district to continue their appropriations to the work of the association for the current year. During the discussion of Mr. Parker's report it was brought out that surveys have been made on both the Deer Creek and the Hailstone sites, on the Provo river. Mr. Parker expressed the opinion that both will be found to be feasible for reservoir purposes. As to the Hailstone site, which would submerge the present Murdock power plant, he hazarded the guess that when the field notes have been platted, it will be found that this reservoir will hold about 40,000 acre-feet, with a dam from 100 to 125 feet high.

VELOCITIES

It was stated on page 86 of the July 15th issue of the Journal of Electricity that the velocity of light is 186,400 miles a second, whereas that of electricity is 284,500 miles a second. According to present theories on this subject, on which much of electrical science is based, the velocities of light and electricity are the same. The error arose from a newspaper item which was clipped as a curiosity and which found its way into the pages of the Journal of Electricity without the necessary explanation.



The cure for all ills of modern civilization is the abolition of power companies, according to the following astonishing document, which is an extract from a letter recently received by the State Supreme Court of California:

Surface current of atmosphere extends about two miles. Above this a current blows 100 miles an hour from Equator to Poles vessicles superheated by Sun Ray, explode, those coming into shade collapse into water particles. Apetite of rarer air for vapor exhausts heat of fluidity of water particles congealing them into ice morsels, abounding above and between the vapor clouds. These entering higher air current are conveyed to and deposited round Poles, to fulfill Dan'l vii. 23, 2nd Peter iii. To avert which Adam was created, with reason. Vapor is practically opaque to radiant heat, which escaping from exploded and collapsed vessicles, is absorbed by vapor, eventually giving tension downwards, preventing evaporation of all surface water. This resistance overcome, vapor will ascend to any altitude and quantity giving rain at request—D.V. Increasing ice caps force water through Planets Strata. Under heat and pressure water dissolves sand forming great Caves or Mines. Coming on heated interior water is changed into Negat Electrified Steam.

Negat Elect'y escaping from interior or forced therefrom by Dynamos by removing tension cause quakes and volcanic action. By Solar Reflection or contrary air currents liberating Latent Heat a partial Vacuum forms into and toward which vapor laden air flows giving off Latent Heat which enters adjacent vessicles imparting tension downwards, being least resistance, forming whirl of reflecting to and fro interior air sweeping ground and Neg Electrified enters and ascends in whirling Cone, as Tornado, distinctive by rapid motion within whirl. A harmless Tornado can be formed by Fan and Horn giving rain almost anywhere.

Accumulating ice caps are crushing in Planets Crust to break in pieces explode and Conflagrate her. This due to ignoring God's Law given instead of Adam's Lost Reason. Ice Morsels impelled outward by impinging Solar Ray. I reason after manner of radiometer, eventually yielded Electric to Gravitation attraction and caused The Deluge pouring Jupiter and Mars water in great part onto Earth. Mars I reason is dead and Jupiter in Conflagration. Telegraph Currents induce Compensatory Currents in ground, supplementing Trolley and Polar Pressure to kill all inhabitants of globe by Flu, Sleeping Sickness, Spasmodic Contraction of Heart, Insanity, Apoplexy or Paralysis.

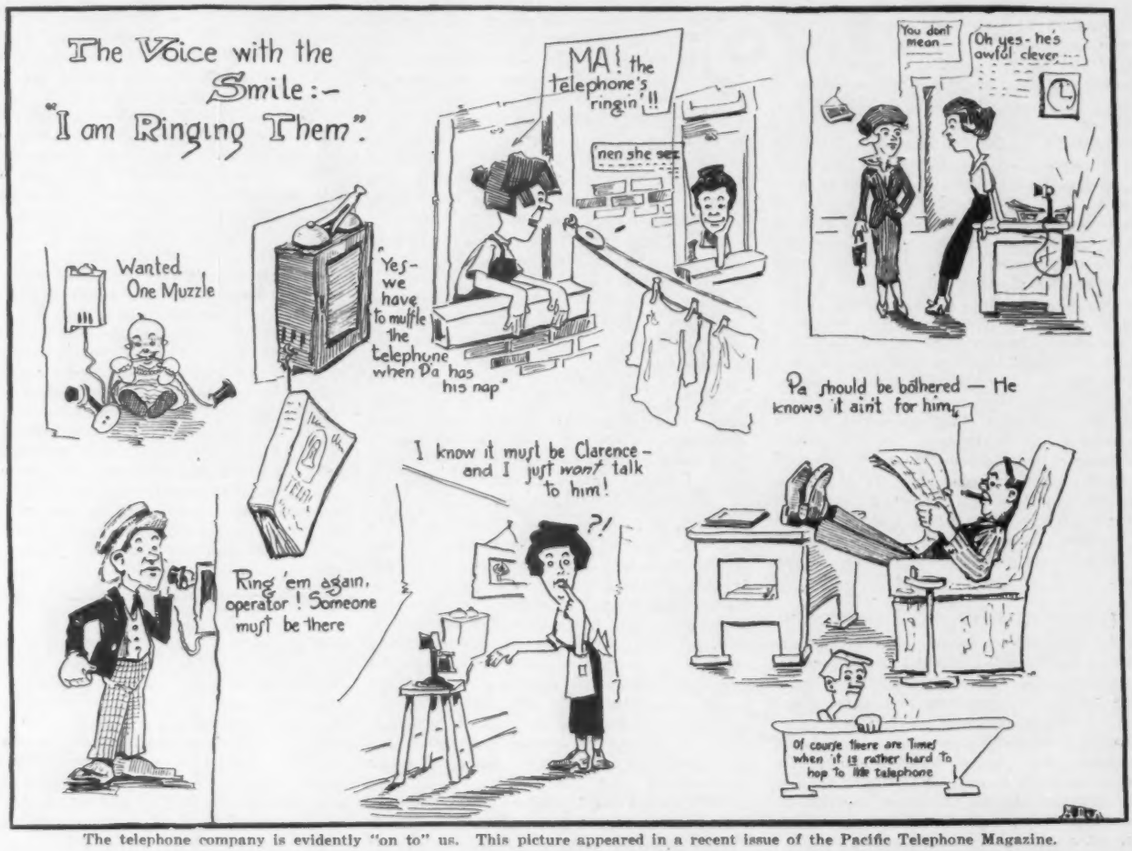
Remedy:—Suppress Electric Companies. Fix fine points on summits of iron and steel structures to diffuse upward. Bring rain on deserts to disperse Neg Electy and establish Vapor connection between Equator and Poles to relieve Polar Pressure.

* * *

Why strike for a six-hour day when an eight-hour day works out so much more satisfactorily? Some one has made the following interesting calculation, which should certainly make people reluctant to change the present blissful arrangement:

	Days
Every year has	365
If you sleep 8 hrs. a day it equals	122
This leaves	243
If you rest 8 hrs. a day	122
This leaves	121
There are 52 Sundays	52
This leaves	69
If you have half-day Saturday	26
This leaves	43
If you have 1½ hrs. for lunch	28
This leaves	15
Two weeks' vacation	14
Which leaves	1
And this being Labor Day: No one works	1

SO YOU DON'T WORK AFTER ALL.


The Voice with the Smile:-
"I am Ringing Them".
MA! the telephone's ringin'!!
nen she sez
You don't mean—
Oh yes - he's awful clever...
Wanted One Muzzle
"Yes- we have to muffle the telephone when Pa has his nap"
Pa should be bothered — He knows it ain't for him
I know it must be Clarence - and I just want talk to him!
?!
Ring 'em again, operator! Someone must be there
Of course there are Times when it is rather hard to hop to the telephone

The telephone company is evidently "on to" us. This picture appeared in a recent issue of the Pacific Telephone Magazine.